Vol. 107 No. 2675 THURSDAY AUG 28 1952 9d.

THE MODEL ENGINEER

The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

28TH AUGUST 1952 VOL. 107 NO. 2675

SMOKE RINGS

Our Cover Picture

● THIS WEEK our photograph shows how a model can recapture the beauty of something which may be, before long, a thing of the past. The spritsail barge rig is being replaced, gradually though it may be, by the internal combustion engine, and in a few years time it is likely that the last of those lovely ships will be seen no more. To some, they are merely rather grubby, clumsy, work-a-day craft. This point of view is excusable in those who may have seen them only at the quayside. The beauty of their hull lines is not immediately obvious, and their rigging, seen mixed up with cranes and warehouses, has no special appeal to the average observer. But out at sea, in their natural element, they are magnificent craft, and even when loaded down to the gunwale they give an impression of buoyancy and power. With their lofty rig heeling over to a stiff breeze they are in their way as beautiful as a yacht, and they have the added attraction of being useful workers whose efforts are vital to the well-being of the community. The model in our picture carries a heavy false keel for the purpose of sailing, but otherwise is true to scale, and gives one a very realistic impression of the prototype. It was built by Mr. J. Starkey, of the Southend Model Power Boat Club, who is well known to many of our readers. The photograph was taken at the recent Prototype Sailing Regatta at Hove, where a number of spritsail barges, square riggers, galleons, junks, schooners and sailing models of various types were to be seen in action. An illustrated report of this event will appear in the September issue of our companion magazine, *Model Ships and Power Boats.*

Malden Gala Day

● MR. GEORGE C. SMITH, hon. secretary of the Malden and District Society of Model Engineers, advises us that the annual gala day at the society's locomotive track, Claygate Lane, Thames Ditton will be held on Sunday, September 7th.

This happy occasion is usually held on the Sunday following THE MODEL ENGINEER Exhibition, but since the latter does not take place this year, until the end of October, the Malden society feel that this is rather late in the season to plan an outdoor event such as a track gala day. We agree, and we hope that the date chosen for the Malden event will be blessed with good weather so that everybody present will be able to enjoy it to the full. If anyone should require further information, Mr. Smith's address is: 101, Tudor Drive, Kingston-upon-Thames, Surrey.

Southport's Fifth Exhibition

● THE SOUTHPORT Model and Engineering Club has announced that its fifth exhibition will be held, from September 27th until October 4th next, at Chapel Street Congregational Hall. On the first day, the exhibition will be open from 1 to 10 p.m., but on the other days, except the Sunday, the hours will be 10 a.m. till 10 p.m. The actual opening ceremony will take place at 2 p.m. on Saturday, September 27th.

There are to be competitions for aircraft, engineering, railways, ships, juniors and ladies' work. There is also to be the first miniature Grand Prix car racing on a portable track in the north of England, the club's "OO"-gauge model railway layout and extension under construction, film shows of general interest, modellers at work and a large number of models of all kinds.

Any further information required can be obtained from the hon. secretary, Mr. A. M. Moore, 22, Stafford Road, Birkdale, Southport.

The "M.E." in a Hot Spot

● ONE OF our overseas readers was telling us, the other day, that during a flight over North Africa, the aeroplane in which he was travelling had to make a forced landing on the aerodrome at Khartoum. The temperature was 153 deg. F. in the sun; it was like breathing fire! Our friend, together with other passengers, made a bee-line for the air-conditioned waiting-rooms. Here the temperature was 109 deg.—44 deg. cooler than outside, and consequently comfortable, by comparison—but it was still much hotter than the average Briton considers normal. Among a selection of periodicals displayed for sale was a copy of THE MODEL ENGINEER!

Portsmouth and District M.P.B.C.

● AT THE recent flower show held in the Castle Field at Southsea, the Portsmouth and District Model Power Boat Club provided a very successful display of members' work; more than forty models were on show, ranging from craft of 1 ft. to 8 ft. in length, and varying in size and power.

Mr. J. F. Russan, hon. secretary of the club, who has sent us this news, says that the members are grateful, not only for the keen interest shown, but also for the exemplary behaviour of the large crowd that was continually passing through the display tent. Messrs. J. Sidey, T. Wood, J. Hampton and J. Russan, very ably headed by Mr. J. Abrahams, formed a very efficient body of stewards.

During the last six months, the club has held fortnightly meetings at which talks and demonstrations on such subjects as: "Experimental Work on Models," "Remote Control," "Practical Boatbuilding" and "Cruises Round the Coasts of the U.S.A. and Canada" have been given.

Under the able direction of its chairman, Mr. F. Downing, the club seems now to be on a firm basis, and the enthusiasm of old and new members alike augurs well for a happy future, even though the running time allowed is only on Sundays from mid-September till mid-June. We extend to all members of the club our warmest wishes for every success, and we shall be glad to receive more news of them, from time to time.

Aids to Education

● WE HAVE received an interesting letter from Mr. D. H. Abbott, of the Newport Technical College, reporting the fact that junior engineering students at the college are building miniature locomotives as part of the technical education. Unfortunately, some photographs sent by Mr. Abbott, to indicate progress to date, are not suitable for reproduction; but he writes:—

"The 0-6-0 is a 5-in. gauge *Butch* which is being built, and represents the efforts of about fifteen students, to date, each of whom, in his last year in school has been responsible for completing a certain component or part. It has taken nearly two years to progress this far, but it must be remembered that the students are in the workshop for only 2½ hours a week. Several parts not visible, such as axle-driven water pump, coupling-rods, connecting-rods and parts of the brake gear, are completed.

"The students are very enthusiastic about this project, and a record book is kept containing details of the work executed by each student. This record will be kept with the locomotive, when completed and tested, and kept in the college.

"The other chassis I hope you will identify as that of *Britannia*; it has been built according to 'L.B.S.C.'s' instructions by myself."

We are sorry we could not reproduce any of the photographs, but they certainly confirmed Mr. Abbott's letter and they showed that, in both cases, some excellent work is being done.

A New Locomotive Boiler

● WE LEARN that British Railways are to carry out experiments with a type of locomotive boiler which, we understand, has been tried successfully on the Continent and is claimed by its Italian inventor to achieve considerable fuel economy.

The Franco-Crosti boiler, as it is called, is to be fitted to ten Class 9, 2-10-0 heavy freight locomotives of a new standard design, which are to be built under the 1953 locomotive building programme. The design is such that the engines can be fitted with either the new type or the orthodox type of locomotive boiler, with only slight modification.

This is interesting news, and we are wondering whether the Franco-Crosti boiler, when full particulars of its design and construction become available, will be found to be adaptable to model locomotives. If it should prove to be so, it will provide a new source of interest for our locomotive enthusiasts, some of whom are apparently keen on finding a more efficient type of steam generator than the more orthodox pattern of locomotive boiler.

In full-size locomotive engineering, somewhat similar experiments have been made in the past, and we seem to recollect that improved boiler efficiency has been claimed for some of the experimental boilers built and tried in steam. The plain fact remains, however, that up to the present, none of these experiments has resulted in producing a boiler that is so satisfactory as the Stephenson boiler in service.

THE MECHANICS OF RADIO CONTROL

by Raymond F. Stock

THE electronic side of radio control still offers a wide field for experiment by the radio enthusiast, particularly in the higher frequency band. The design of equipment for 27 Mc/s has, however crystallised into a few basic types during the last few years; examples of each type are available commercially, and each class of equipment has been described in the modelling press. The amateur who approaches the subject from the modelling aspect rather than the radio field has, therefore, as good a chance as anyone of obtaining interesting results.

With the exception of multi-channel systems, all commonly used types of radio gear terminate in a simple relay at the receiver which closes one of two contacts according to whether the transmitter is switched on or off; it may be assumed that the transmitter can be keyed by manual or automatic means to produce any number or combination of pulses, either intermittently or continuously, and that the receiver relay will follow these fairly exactly at all ordinary speeds. These pulses then are the raw material of radio control in its simpler form; whatever complex control movements are required must be initiated by them.

The purpose of this article is to consider some of the points arising in connection with the design of electro-magnetic control gear.

Escapements

The best known apparatus for converting current pulses into control movements is the escapement. In this device a wound spring or skein of rubber is connected to a shaft which thus constantly tends to rotate; it is prevented doing so by a ratchet wheel restrained by a claw mechanism. Fig. 1 shows a typical wheel and claw arranged for four control positions, and power is taken by a connecting-rod from crankpin **A**. The other end of the connecting-rod would be pinned to the rudder-head in a boat, so that the sequence of operations would be Port-Neutral-Starboard-Neutral.

In Fig. 1 the two claws **X** and **Y** are spaced around the periphery of the ratchet wheel by 135 deg. Generally, however, many ratchet teeth (and, therefore, control positions) are used, the spacing of the claws should be an odd multiple of $\frac{1}{2}$P where P = ratchet wheel pitch. The exact number of $\frac{1}{2}$P chosen should be as large as convenient to avoid making the effective radius of movement of the claws too cramped.

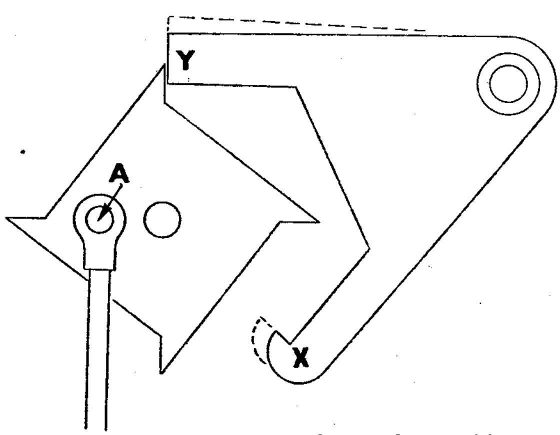


Fig. 1. Simple escapement having four positions

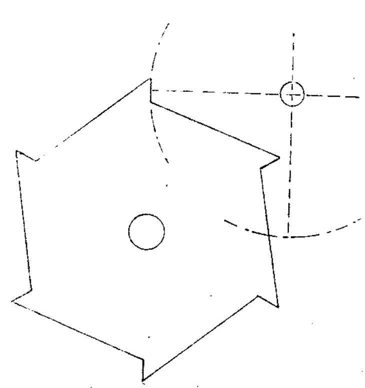


Fig. 2. Laying out the geometry of a six-step claw mechanism

Having decided upon the angular spacing of the claws, a tangent to the ratchet wheel pitch circle should be drawn from each claw position, and the intersection of these lines gives the pivot point for the claw assembly. Fig. 2 shows this construction and it will be seen that this arrangement (plus a large spacing between the claws) enables both claws to move as nearly as possible truly radially to the ratchet wheel centre. By doing so, the claw assembly does the minimum work against the drive spring, most of the loading on it being purely frictional.

It is very desirable to keep the movement of the claw assembly to a minimum, and this means reducing the overlap of claw and tooth. In order to retain a sufficient area of contact between the two, they should be extended axially. A thick heavy wheel is then avoided by using riveted-on teeth, and Fig. 3 illustrates a suitable built-up construction for both wheel and claw assembly. The teeth should be of hardened

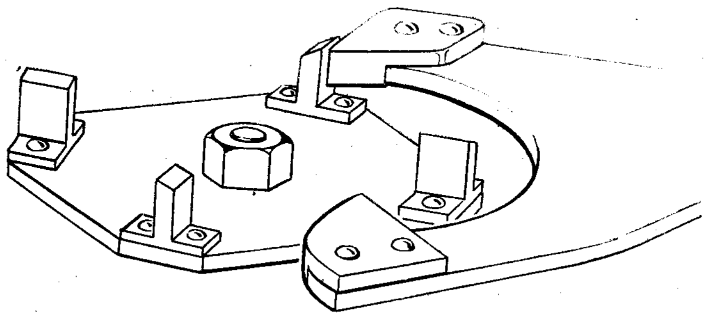


Fig. 3

steel, since they are subjected to a good deal of hammering in use, and an obvious material for the wheel and claw frame is duralumin.

A useful variant when the amount of mechanical power to be handled is large, has been illustrated in Fig. 4. Here the 6-position cam or crankshaft **A** is geared up 1 : 6 to a separate escapement shaft **B**, and the latter has, therefore, only one tooth. This system reduces the loading on the escapement, and consequently reduces the amount of electrical power required to actuate it.

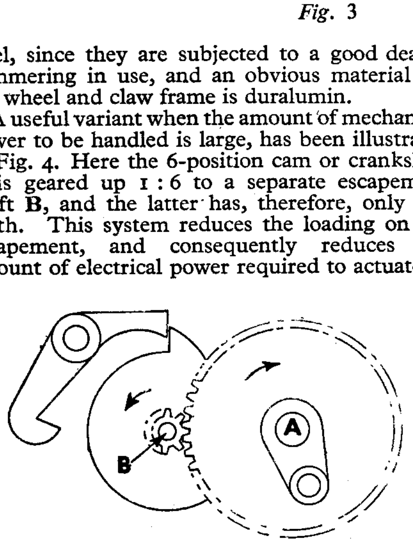


Fig. 4. *Using a geared-up escapement shaft*

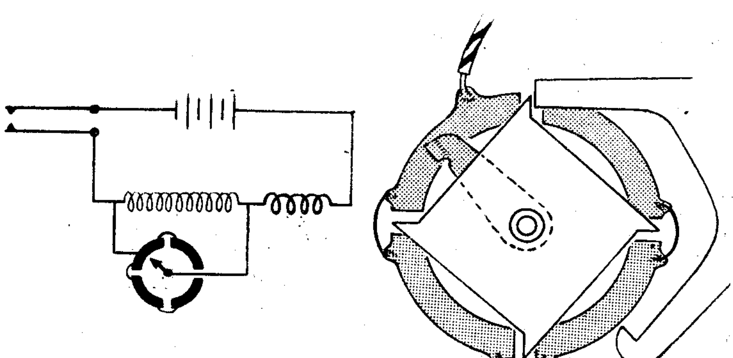
All escapements move from one position to the next in two steps; the intermediate step (when the second claw is restraining the wheel) may be used as an additional control position halfway between every normal control point. Unlike the latter, however, the intermediate positions require the use of electrical energy to retain the claw assembly whenever these positions are held. This trouble may be minimised by wind- the operating electromagnet with two coils, one of high and one of low resistance. The former is normally shorted out by a pair of contacts operated by a cam on the escape wheel, or by a wiper arm on the wheel, so that the electromagnet operates in the normal way on its low resistance winding. When the armature is fully home and the wheel has completed its first movement, the contacts short-circuiting the high resistance winding are opened so that the consumption of electrical energy is greatly reduced. The magnetic pull is, of course, also reduced, but as far less power is required to retain the armature closed than to attract it across an appreciable air gap, the claw assembly remains in its operated position. Fig. 5 indicates the circuit and a suitable wiper assembly.

The value of the high resistance winding is ascertained by experiment, with the object of finding the minimum current that will hold the electromagnet positively closed.

Most small clockwork mechanisms convert easily to use as an escapement, as much of the gear train being retained as is needed to give the required torque at the final shaft. As an approximate basis for experiment, I would suggest that not less than two inch/oz. should be obtainable at the usable limit of spring run for an i.c powered boat of about 30 in. length.

This assumes a balanced rudder working in "easy" bearings. Obviously the question of available torque is bound up with the number of complete operation cycles required between winding the spring. Fig. 6 is a photograph of a spring escapement fitted to a 32 in. i.c. model the gear train and spring being taken from a clockwork boat unit, and fitted between duralumin frames.

Fig. 5. *A four-step claw arranged for eight positions*



An eccentric adjustable stop is fitted at **A** to limit the backward movement of the claw assembly, and the forward movement is limited by the armature coming home against the pole-

pieces of the electromagnet **B** which is itself adjustable for position. The two contacts seen mounted on the electromagnet are used to pick up the operating pulses from the superstructure which houses the complete radio gear and batteries.

This idea I would recommend to any newcomer to the hobby, as it enables the radio to be serviced easily, apart from the hull, and forms a self-contained damp-proof unit which is removed from the hull during such messy operations as starting the motor, refuelling, baling out and cleaning the hull.

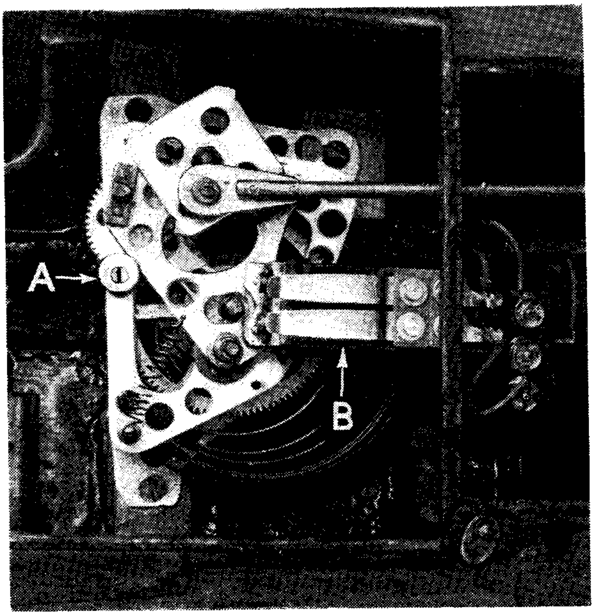


Fig. 6. The claw is built up with steel teeth on a duralumin frame, but the escape wheel is cut from $\frac{1}{8}$-in. steel. The escapement battery is on the right

Fig. 7 shows the superstructure of this model (which has done much service as a floating test bed) and within an overall length of 16 in. contains (**A**) an L.T. cell, (**B**) an H.T. unit—$67\frac{1}{2}$ volt hearing aid battery and (**C**) the radio. The aerial seen is functional. The receiver circuit is that noted in my article of February 28th, 1952, issue of THE MODEL ENGINEER.

An installation of this size is probably as large as one would want to go using a simple escapement. At the other end of the scale it is possible to utilise a rubber-driven escapement in very small models (toys ?), an example being my little tug described in THE MODEL ENGINEER, No. 2618, which also notes another type of modern receiver.

The limitations of an escapement are its relatively crude steps which make fine control impossible. One can, of course, always increase the numbers of positions, but the average time lag

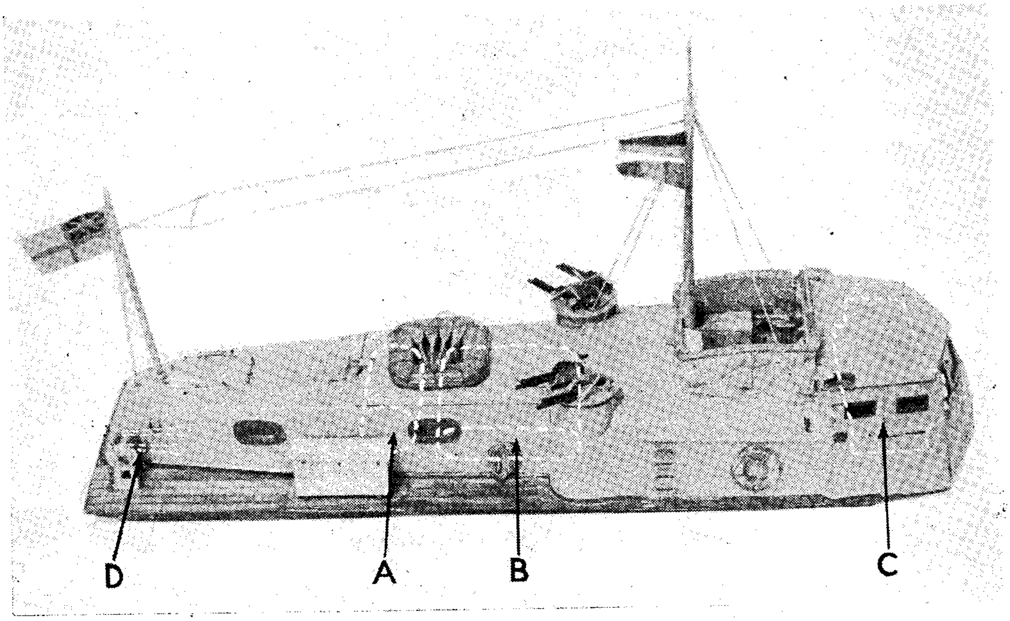


Fig. 7. A hatch gives access to both batteries, and the wheelhouse deckhead may be removed to adjust radio and controls. The contacts " D " pick up on those shown in Fig. 6

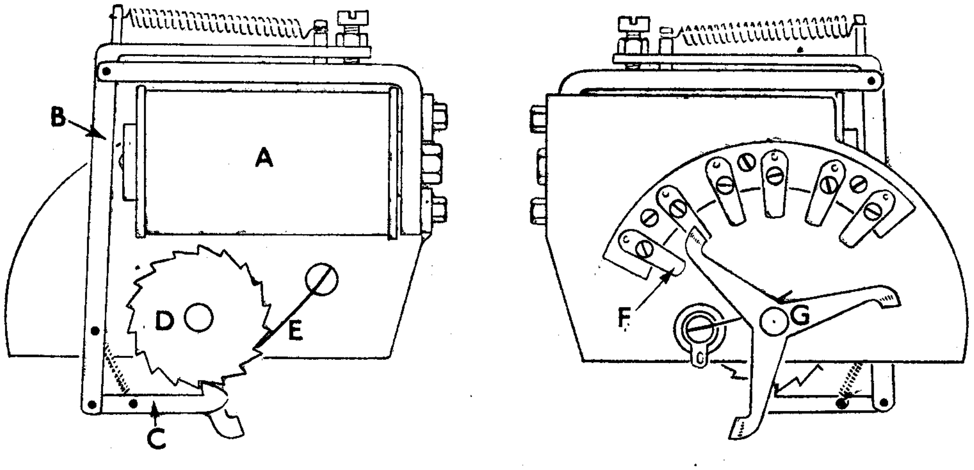


Fig. 8. Circuit selector. The overall width is about $3\frac{1}{4}$ in.

increases pro rata, and more important, the human brain seems incapable of memorising the sequence above six steps or so. Automatic transmission of pulses may be a solution here; but a pulsing device which gets out of phase is a greater menace than none at all!

Selectors

Perhaps the next stage beyond escapements is the circuit selector. This device receives pulses from the relay, but instead of releasing useful mechanical power it produces a rotary movement of its shaft—in steps, of course. Mounted on the shaft is a wiper arm, which, as it steps round, energises a number of contacts in turn. These contacts may be used to actuate motors, solenoids or electromagnets to provide control power.

The construction of a selector is shown in Fig. 8. **A** is an electromagnet and **B** its armature carrying the spring-loaded pawl **C.** This rotates wheel **D** which is provided with a detent **E.** It will be seen that the electromagnet does not shift **D** directly—the wheel is rotated on the backward, spring-impelled movement, and this is important. I have not been able to make a selector work satisfactorily except on the backward movement where the impulse (being generated by a spring) is constant. If the action is reversed, a new battery with its increased power tends to make the wheel overshoot; one of the essentials in construction is accuracy, so that the wiper arm stops quite positively on each contact.

Selectors are available in the surplus market, but as they often have four or more banks of wipers and contacts, they use about 12 W of power and are unduly large. Useful ones may, however, be made fairly simply on the lines shown in Fig. 8 the moving parts being of steel and the frame aluminium. Soft-iron is used for the magnetic circuit. It is normally necessary to use rather small teeth on the wheel and one generally finds that the number of circuits to be controlled is fewer than the number of teeth (i.e. steps). It is usual, therefore, to make the number of teeth a multiple of the steps required and to fit two, three or four wiper arms. Fig. 8 shows 18 teeth, 6 contacts (**F**) and 3 wiper arms (**G**) a convenient arrangement giving control over 6 circuits.

The way these circuits are used must depend upon individual requirements, but a typical case might use three positions to control the steering motor (thus (1) R.H. rotation = Port;

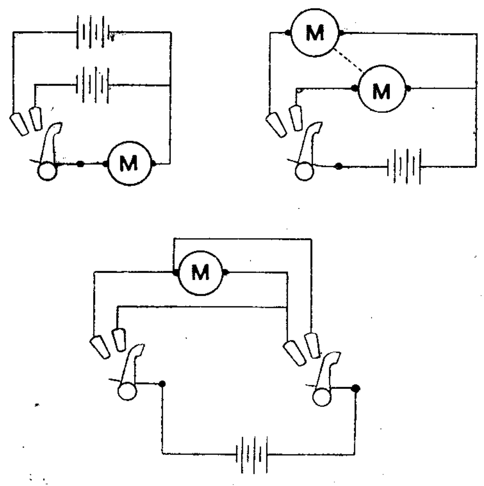


Fig. 9. Three methods of obtaining reversible rotation of a shaft

(2) L.H. rotation = starboard, and (3) off), and the other three positions for operating additional gear. With this layout the rudder could be started turning in the correct direction with little time lag, and the rudder angle would depend on a time factor—i.e., the time for which the motor was allowed to run before stepping to "off."

A simple selector with one bank of contacts will require either two batteries or two motors to produce directional control of the rudder; if a two-bank wiper assembly is employed, one motor and one battery may be used. These points are illustrated by the diagrams in Fig. 9.

A simple 3-way control of steering as outlined above is practical, but makes it very difficult to find the "amidships" position except by trial and error, so that the model tends to proceed in a series of arcs. The best solution is to use one of the "spare" positions for housing to "amidships," thus leaving two spare positions on a 6-step selector.

This is done by fitting a brush to the rudder head and making it track over two curved arcs which have a small insulating segment between them. In the homing position, current to the motor is supplied from the brush, which picks it up from one or other of the two arcs. The polarity

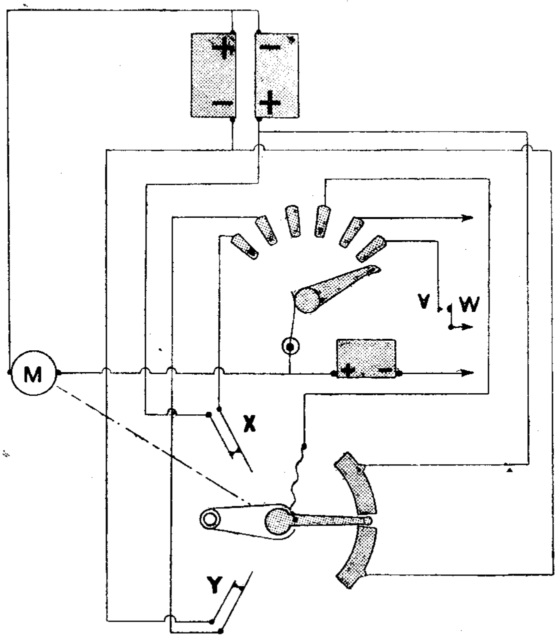


Fig. 10. Reading from left to right, the contact positions represent port, starboard, hold, amidships, spare, and spare (delayed)

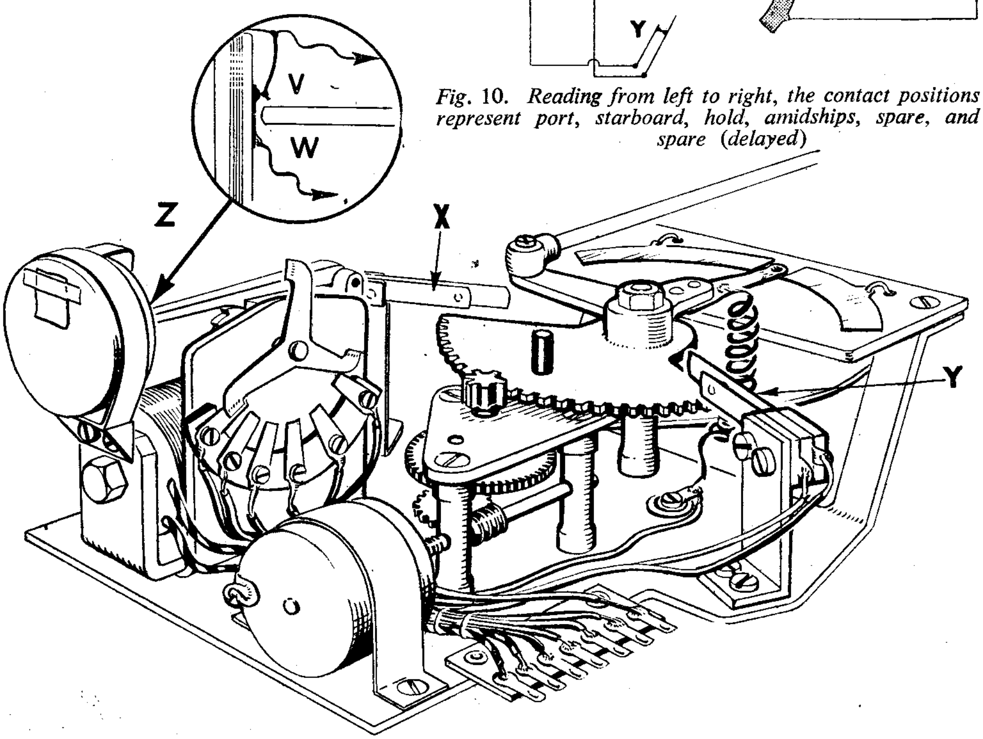


Fig. 11. Complete steering unit based on the circuit of Fig. 10. Overall size about 6 in. long

of these is arranged to cause the motor to bring the rudder to the centre, wherever it may be initially. Fig 10 shows the circuit and Fig 11 is a line drawing of a complete installation on these lines which has been used successfully.

Two other features are noted in Figs. 10 and 11. The first is the inclusion (at **X** and **Y**) of two limit switches to stop the motor at the extremes of rudder travel; this is a very desirable feature since it involves negligible extra complication. The second feature is **Z** on Fig. 11, which is a commonly-used type of delay device inserted in one of the spare circuits.

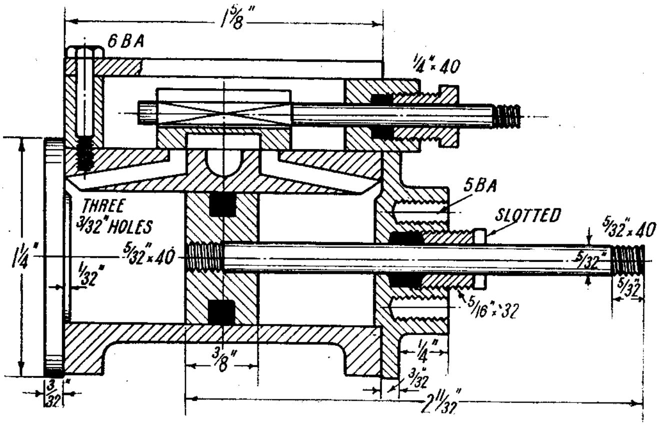
(To be continued)

The "Canterbury Lamb"

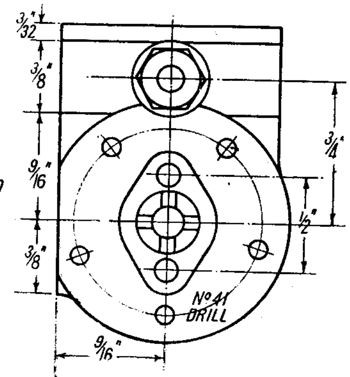
in $3\frac{1}{2}$-in. Gauge

by "L.B.S.C."

THE design of the cylinders for the small *Invicta* is based on those specified for *Rainhill*, the other "old iron" which proved a great success; but experience still teaches, so a little improvement has been made. I found, on laying out a plan of the motion, that by letting the big-end of the connecting-rod run close to the coupling-rod, and putting the flange of the bush completely inside, the centre-line of the cylinders could be brought out to a distance of $\frac{9}{16}$ in. from the frame, instead of the 15/32 in. on *Rainhill*. The extra 3/32 in. doesn't *sound* much, but it makes a whale of a difference when you are drilling and tapping studholes in the bolting face and have that little bit extra as insurance against piercing the cylinder bore. There is also a greater thickness of metal between the top of the bore, and the portface, which renders it easier to drill the passageways. There will also be no need, in this case, to bring up the exhaust through the wall of the steamchest; owing to the steep inclination of the cylinders, the "entrance to the way out" is well above boiler centre, and the exhaust pipes can be attached direct to the cylinders. The steam chest is a little shallower, but is still of ample size; and there is plenty of room for big ports, and slide valve to match. Steam enters over the top of the valve.



Section of cylinder



Back end of R.H. cylinder

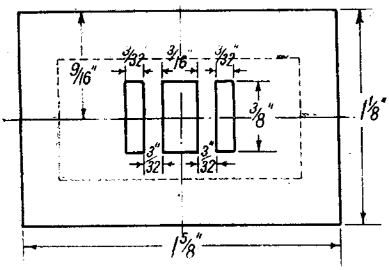
Lubrication of *Rainhill's* cylinders was effected by "dope cups" located on the steamchest covers, to make the job easy; but many builders added a mechanical lubricator off their own bat, taking one of my "standard" designs and hanging it up under the engine. This time I am specifying a mechanical lubricator, to be driven from the pump eccentric, by extending the pump gudgeon-pin to take the ratchet drive rod.

Machining Cylinder Castings

The cylinder castings are machined up in a manner similar to that fully described for *Tich*, so I need only give a synopsis of the *modus operandi*. If your lathe hasn't a self-acting feed, or at least a leadscrew with handwheel—oh, for the days when anybody could buy a 4 in. Drummond screwcutting lathe complete, for the sum of five pounds sterling!—set the top slide to turn parallel, by putting a piece of round rod in the chuck, with about 2 in. projecting, and taking a fine cut along it. Test for parallelism with "mike" or calipers; if the "mike" reading doesn't show a greater variation than half-a-thousandth or so, between the ends of the cut, or if you can't detect any difference in the "feel" of the calipers at each end, the slide is O.K. If you get a bigger variation, adjust the top slide until the desired result is obtained. Use a sharp tool and take a light cut—two or three, if you like—otherwise the work will spring, and you'll get false readings.

Smooth off any roughness on the portfaces of the cylinder castings with a file, and check the corehole to see if it is in the right position. If it is, no marking-out is needed; if it isn't, plug the end with a bit of wood, and mark on it the centre of the finished bore, scribing a circle $\frac{11}{16}$ in.

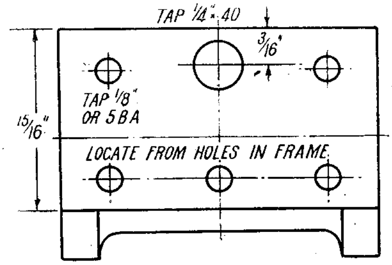
diameter from the mark. Mount the casting, port-face down, on an angle-plate attached to the faceplate, securing by a bar across its back held by a bolt at each end. Set the casting parallel with lathe centre-line, by applying a try-square, stock to faceplate, and blade to bolting face of casting ; then adjust the angle-plate on the face-plate until the corehole, or scribed circle, as the



Port face

case may be, runs truly. Tighten all bolts, but not sufficiently to spring the work ; the end of each casting should overhang the angle-plate a little. Don't forget to put a balance weight opposite angle-plate.

Face off the end with a round-nose tool set crosswise in the rest ; then mount an ordinary boring tool, or cutter bar, and take a good deep cut through the corehole, to clean out all scale and sand. Open out with successive cuts until you can just enter the "lead" end of an $\frac{11}{16}$ in. parallel reamer in the bore. This should leave only a couple of thousandths or so, for the reamer to take out. Put a tapwrench on the shank, or a lathe carrier, hold the reamer against the tail-stock centre, and run it through the bore by sliding the tailstock bodily along the bed. The

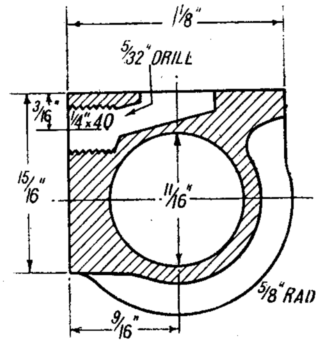


Bolting face

only stop should be for reversing, otherwise the bore will be ringed. If you haven't a suitable reamer, bore to size, and take two or three traverses through the bore without shifting the cross-slide. This will give an excellent finish, provided that the boring tool or cutter is sharp, and ground to correct clearances. To finish the other end, turn a bit of rod of suitable diameter to a tight fit in the bore ; hold it in three-jaw, put the cylinder tightly on to it, unturned end outwards, and judicious application of a round-nose tool will soon do the needful. The overall length should be $1\frac{5}{8}$ in., and matters should be so arranged that the flanges at both ends are of equal thickness.

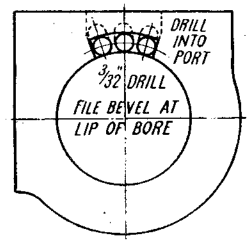
Port and Bolting Faces

Up-end the casting on the angle-plate, and secure with a long bolt through the bore, with a big washer and a bit of soft metal under the nut, to prevent damage to the faced end. To set truly,



Section through exhaust port

apply the try-square, stock to faceplate, and blade to port face ; the bolting face will then be O.K. for facing off with a round-nose tool. Set the angle-plate so that the casting is approximately central with the faceplate, and let the casting overhang a wee bit. Face off until there is just 7/32 in. of metal left between the face and the edge of the bore. Now slew the casting around a quarter-turn, and reset with the try-square, this time applying the blade to the face just machined, which will bring the portface at right-angles to it. Then go ahead and face that part, until within 7/32 in. of the bore, as before. If you've done the job properly, the centre of the bore will be $\frac{9}{16}$ in.



End of cylinder, showing passages

away from both port and bolting faces, which is correct.

Ports and Passageways

Full instructions for the important job of port cutting were given in the *Tich* serial ; if you have back numbers, look it up. Briefly, mark out very carefully, each portface according to the dimensions given in the illustration. A marking-out fluid can be made by dissolving shellac in methylated spirit and adding violet or blue aniline dye. This dries in a few seconds when painted on

bright metal, and can be rubbed off with a meth-wetted rag. It shows the markings as bright lines on a deep violet or blue ground, and oil won't wash it off.

If you have a vertical slide, which every home-workshop lathe user should have (lathe makers should supply one as part of the standard equipment) bolt a small angle-plate to it, and up-end the casting on it, as described above, with the port face facing the mandrel, and at right-angles to lathe centre-line. Put a 3/32 in. end-mill or slot drill in the three-jaw, adjust vertical slide so that the marked port is exactly opposite the cutter, feed into cut with the top slide, and traverse across the cutter with the cross slide. Mind you don't "overshoot the platform"; either count the turns of the cross-slide handle for each traverse, or fix up a temporary stop. A clip on the cross-slide would do. If you haven't a vertical slide, set up the casting on the slide-rest or saddle, with suitable packing. Incidentally, that much-regretted five-pound Drummond had vertical adjustment—haven't things "progressed"! The exhaust port can be cut either with a $\frac{3}{16}$ in. cutter, or by two or three traverses with the smaller one, adjusting height of casting accordingly. Cut all ports $\frac{1}{8}$ in. deep, and leave the ends rounded.

Ports may be cut by hand, drilling holes close together, $\frac{1}{8}$ in. deep, on the centre-line of each, and chipping into slots with a little chisel made from silver-steel. Chief requirements are a straight eye, steady hand, and patience. Passageways can be drilled on a bench or pedestal drilling machine, by holding the block in a machine vice on the table. Make three centre-pops close to the lip of the bore, at each end; then hold the casting in the vice at such an angle that a vertical line drawn downwards from the pop marks would go slap into the bottom of the port. All I ever do, is to put the machine-vice, with the casting in it, by the side of the drill in the chuck on the machine, and pull down the handle. By stooping until my eyes are level with the casting, I can see in half-a-jiffy whether the drill is going to hit the bottom of the port, or go astray. If the latter, the angle of the casting in the vice is altered as required, and the holes are then drilled in two wags of a dog's tail. The stop on the spindle of the machine is set so that the three holes are exactly the same depth, and the drill can't over-run and break into the exhaust port. This stop setting does for all the four lots of holes. The exhaust-way is drilled and tapped as shown in the drawing, which explains itself.

File or mill a bevel at the lip of each bore, the length of the three diameters. If you make it too big, the cylinder cover gasket might probably split and start blowing badly, just as you're going nicely up the 1 in 41 to Tyler Hill Tunnel—and there will be a few more fresh words added to the dictionary of railroad Esperanto! Finally, run the $\frac{11}{16}$ in. reamer through the bores again, by hand, in case the drilling has caused a slight distortion at the end of the bore, as it sometimes will. If you have no reamer, try with your finger; if the smoothness doesn't feel perfect, scrape the bore slightly, just below the holes, with a triangular scraper made by grinding the teeth off the end of any old three-cornered file that has seen its best days on its legitimate job.

Cylinder Covers

The front covers are just plain turning jobs needing no description, and the back ones are little more. Chuck by the tenon provided, turn the register an exact fit in the bore, face flange and turn edge to size; centre, and drill right through with No. 21 drill. Reverse, either holding by the edge in three-jaw, or in a home-made step chuck as described for *Tich*, which I recommend, as I use them myself. Face the boss, cutting the chucking tenon right off, and face as much as you can of the cover without cutting into the boss. Open out the hole to $\frac{1}{4}$ in. full depth with 9/32 in. pin drill, which ensures concentricity (corluvaduck, ain't we a-gettin' posh) and tap $\frac{5}{16}$ in. × 32 or 40. I've explained several times how to drill the screwholes in the covers, without any marking-out, using an old commercial steel washer for a drilling jig. In this case, use one about the same size as the covers, and bore the hole in it to $\frac{11}{16}$ in. diameter, so that it just fits the cover spigots or registers. Set out the location of the screwholes on it—don't forget the little extra space at the passageway point, so that a screw will come at each side of the passage entrance as shown—and drill them No. 41; then all you have to do is to clamp the jig to each cover, and drill through the lot. Set the jig on the back covers, so that the resulting holes will clear the ends of the passageways when the bosses are vertical; that is, parallel with the bolting face, as shown in back view of cylinder.

Scrape off any burrs left by the drill, then fit the covers to the cylinders, using the holes in them to mark off those in the cylinder flanges, by putting the No. 41 drill through each, and making countersinks. Drill these No. 48, and tap 3/32 in. or 7 B.A. Attach covers temporarily by a couple of screws in each, then file the projecting bits of cover flush with the bolting face on each cylinder. Make a dummy plug for the stuffing-box on the back cover, and mark the centre on it. Lay the cylinder, bolting face down, on the lathe bed, or anything else that is flat and true; set your scribing-block needle to the centre mark and scribe a line down the middle of the boss. On this line, at $\frac{1}{2}$ in. above and below centre, make centre-pops. Take off the front covers, leaving the back ones in place; and with the cylinder standing on the drilling-machine table or resting it against a drilling pad on the lathe tailstock, drill No. 40 holes a full $\frac{3}{16}$ in. deep, and tap them $\frac{1}{8}$ in. or 5 B.A. This will ensure parallelism and alignment of the guide bars.

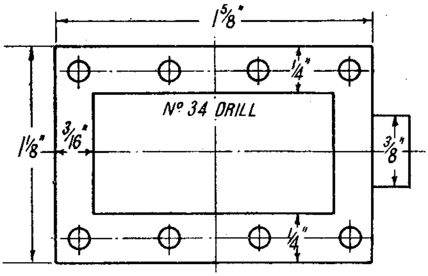
In case your three-jaw isn't as virtuous as Mrs. Caesar was reputed to be, turn the glands from $\frac{3}{8}$ in. bronze or gunmetal rod. Turn down about $\frac{3}{8}$ in. length to $\frac{5}{16}$ in. diameter, and screw $\frac{1}{4}$ in. of it to match the stuffing-box. Face the end, centre, and drill down with No. 23 drill for $\frac{3}{8}$ in. depth. Slightly countersink the end, part off at $\frac{5}{16}$ in. length, and file or mill two slots crosswise across the end. Screw into stuffing-box and poke a 5/32-in. parallel reamer through the lot.

Pistons and Rods

The piston-rods are just two pieces of 5/32 in. round rustless steel or drawn bronze rod (either nickel or phosphor will do) each 2 11/32 in. long. Screw one end 5/32 in. × 40 for $\frac{3}{16}$ in. length,

and the other for 5/32 in. length, using die in tailstock holder and holding rods in chuck.

The pistons may be made from cast or drawn material, as available. If cast, it should be a different grade to the cylinders ; our advertisers will supply suitable metal. If separate castings are used, rough-turn each to 1/64 in. over finished size ; face the end, centre, and drill through with No. 30 drill. Reverse in chuck, face the other side to bring the width to 3/8 in., put a No. 22 drill halfway through centre hole, and tap the rest 5/32 in. × 40. If rod is used, chuck in three jaw and rough-turn and drill as above, parting off 3/8 in. from the end ; reverse, open out, and tap. Put piston-rod in tailstock chuck, run up to piston in three-jaw, enter the screwed end, and pull belt by hand until rod is right home. For finishing, chuck the piston-rod either in a collet chuck, or a split bush held in three-jaw (for details, refer back to *Tich* serial) and turn



Steamchest

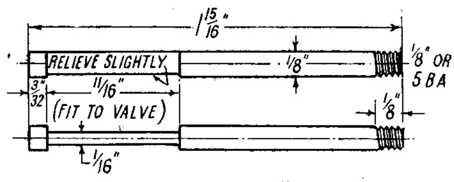
very carefully to an exact sliding fit in cylinder bore. The packing grooves should be 1/8 in. full deep and wide.

Steamchest

The contact faces of the steamchests can be faced off by holding the casting in the four-jaw, and operating with a round-nose tool set cross-wise in the rest. A file will do the needful on the outside. The location of the screwholes is shown in the drawing ; use No. 34 drill. The covers are pieces of 3/32 in. or 1/8 in. flat brass plate, 1 5/8 in. long and 1 1/8 in. wide ; they need no machining, but can be used for supporting the steamchests when turning the gland bosses. Put one on top, and the other underneath ; grip the whole lot in the four-jaw, and set the boss to run truly. Face the end, centre, drill through No. 30, open out with 7/32-in. drill to 5/16 in. depth, and tap 1/4 in. × 40. Turn the outside to 3/8 in. diameter. Make the gland from 5/16 in. hexagon rod. Drill a 5/32 in. hole in the middle of each cover, to let the steam in, and then clamp each cover to its steamchest, using the holes in the latter as a jig to drill the screwholes in the cover. Finally, clamp each steamchest temporarily in place on the cylinder and run the No. 34 drill through the screwholes, making countersinks on the portface. Remove steamchest, drill out the countersinks with No. 44 drill, and tap 6 B.A. Ordinary commercial screws may be used (any head will do) or you can make studs, just as you fancy. Not-so-big sister had real old-fashioned blacksmith's studs and nuts.

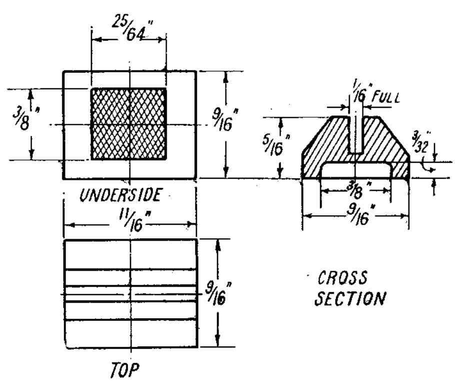
Slide Valves and Spindles

All that remains are the valves and spindles, the valves being made from blocks of bronze or gunmetal cut to shape shown. If a vertical slide is available the exhaust cavity can be end-milled out with the same gadget as used for the ports.



Valve spindle

If not, make a countersink with an 11/32-in. drill, and chip the cavity to dimensions shown, with a little chisel made from 1/4 in. silver-steel. The 1/16 in. slot for the valve spindle should be milled with a saw-type cutter on a spindle between centres, the valve being held in a machine-vice (regular, or improvised from bits of angle, as described in the *Tich* serial) but if the requisites are not available, careful sawing and filing will do the trick. The spindle is just a 1 15/16 in. length of 1/8 in. rustless steel or bronze rod, with a flat on each side as shown. This flat must fit easily in the slot in the valve, but there must not be any appreciable end-play ; *very* important that !



Details of the slide valve

Assembly is easy. Rub valve and portface on a bit of fine emery-cloth, laid business side up, on the lathe bed, drill table, or something equally flat. Pack piston with a ring of 1/8-in. square braided graphited yarn (commercial article) scarfed at each end like a metal piston ring. Use oiled brown paper, or 1/64 in. Hallite, or similar jointing, for the gaskets, and pack the glands with a few strands of ordinary graphited yarn. Note—no holes are drilled in the bolting faces until the cylinders are ready for erection, complete with guide bars, crossheads, and connecting-rods ; these will be the next job.

MORE LOCOMOTIVE TRIAL RESULTS

ON July 5th and 6th last, the Birmingham Society of Model Engineers held their locomotive trials on the fine track at Campbell Green, Sheldon, and we have been favoured with a copy of the table showing the results obtained. We reprint this table below, as we think that it will be of interest to many, if not all of our "locomotive" readers, especially if it is studied in conjunction with the article "Miniature Locomotive Performance," published on April 10th last and giving somewhat similar data sent in from other sources.

Owner	Locomotive	Gauge	Amount of coal	Wt. of driver	Wt. of Driving truck	No. of trucks	Wt. of trucks	Wt. of load	Total load.	No. of laps	Results	Remarks
		in.	lb.	lb.	lb.		lb.	cwt.	lb.			
W. Finch	0-4-0T "Ben Avon" ..	5	1	165	25	3	195	15	2,065	14	28,910	Very slippy rails to start with.
T. Daish	4-6-2T	5	1	180	25	3	195	15	2,080	10	20,800	
H. Lockley	0-6-0T	5	1	120	25	3	195	15	2,020	5	10,100	Mr. W. Halliwell driving. Trouble with mech. pumps.
H. Brenholz	2-6-0 "Princess Marina"	$3\frac{1}{2}$	1	160	25	1	65	5	810	—	—	Whistle valve blew out after 2 laps (rtd.).
J. Curtis	2-6-0T	$3\frac{1}{2}$	1	135	24	1	65	5	784	20	15,680	
A. Bragg	2-6-0 "Princess Marina"	$3\frac{1}{2}$	1	165	25	1	65	5	815	10	8,150	
S. Morris	4-4-0 "Dairy Maid" ..	$3\frac{1}{2}$	1	165	25	1	65	5	815	11	8,965	Mr. E. Guy driving.
C. Cokayne	2-4-0 "Petrolea" ..	$3\frac{1}{2}$	1	150	20	1	65	5	795	28	22,260	
J. Curtis	2-6-4T	$3\frac{1}{2}$	1	135	24	2	130	7	1,073	24	25,752	
W. Heaton	4-6-4T "Halton" ..	5	2	165	25	5	320	20	2,750	21	28,875	
J. Owen	4-6-0 S.R.N. 15 ..	$3\frac{1}{2}$	1	145	38	2	125	10	1,428	17	24,276	
J. Balleny	0-4-0T "Tich"	$3\frac{1}{2}$	$\frac{1}{4}$	147	—	2	125	—	272	6	6,528	Run curtailed due to rain. Quantity of coal corrected

The above results are based on the formulae $\frac{\text{Total weight hauled} \times \text{No. of laps.}}{\text{lb. of coal}}$ This formulae gives a practical indication of the efficiency, i.e., the amount of work done (load hauled $\times$ distance) in proportion to the amount of fuel used, of each engine.

Model Power Boat News

by "Meridian"

The Wicksteed and Bedford Regattas

Mr. Rose (Coventry) with his o.h.v. engined "B" class boat "Meteor I"

THE Wicksteed club's annual regatta is always a popular event for power boat exponents, and in recent years entries and visitors have been numerous. The attractions of Wicksteed Park are too many to tabulate here, but it is undoubtably a fine place to bring the family for a day's outing.

The main events at Wicksteed are the races for the Timpson Trophy and the Newman Lowke Cup, which have been competed for at each regatta since 1933. Both events are for Class "A" boats, but the Newman Lowke race is run over 1,000 yds.

The holder of both trophies for 1951 was J. Innocent's *Betty*, which attained the best speeds of her career in winning them. This year, however, both trophies were won by a boat making a first appearance at Wicksteed: J. H. Benson's *Orthon* (Blackheath). The running of this boat seemed very consistent, although not at the best speeds that have been achieved in practice runs.

Both the pre-war veterans *Betty* and *Faro* seem to be off form this season, after some amazing performances put up in 1951. G. Lines with *Big Sparky* was also out of luck, failing to finish in either event, although winning a special prize given by Mr. Newman Lowke, for the fastest lap time in the 1,000 yd. event.

The Paten Cup for 15 c.c. boats was won by J. Rose (Coventry) with *Meteor I*, a boat that has won places in several events recently. An interesting craft in this race was B. Stalham's *Starlet* with the vee-twin supercharged engine installed. As usual with new boats, teething troubles were in evidence, although a few laps were covered at a moderate speed.

A large entry contested the Douglas Cup for 10 c.c. boats, but several boats failed to finish the course. Best performances were by W. Everett's *Nan* and S. Poyser's *Rumpus* 3 both of the Victoria Club.

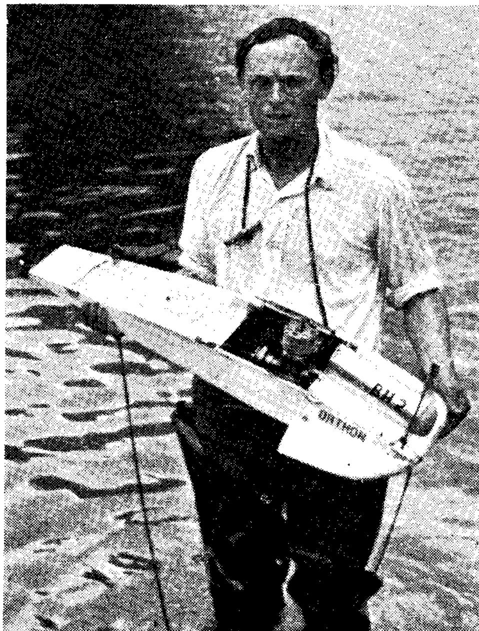
Results

Timpson Trophy Race, 30 c.c. Boats, 500 yd.
1. J. H. Benson (Blackheath), *Orthon*: 49.41 m.p.h.
2. K. Williams (Bournville), *Faro*: 46.07 m.p.h.

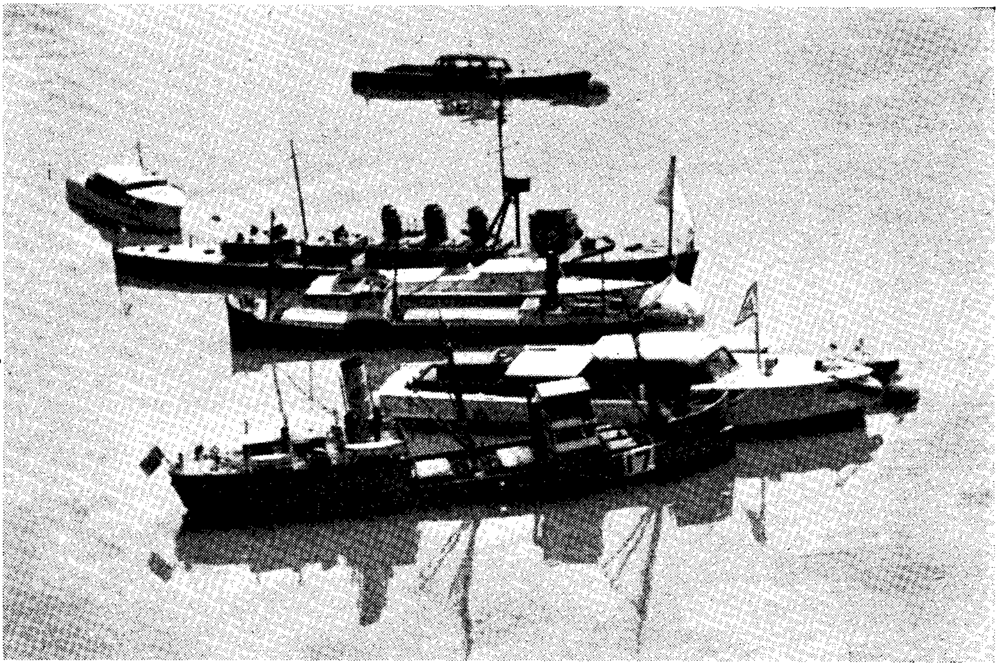
Steering Competition
1. J. B. Skingley (Victoria), *Josephine*: 9 pts.
2. Mr. Emery (Bedford), *R.A.F. Launch*: 4 pts.

Paten Cup Race, 15 c.c. Boats, 500 yd.
1. J. Rose (Coventry), *Meteor I*: 44.8 m.p.h.
2. B. Stalham (Kings Lynn), *Tha II*: 36.3 m.p.h.

Douglas Cup Race, 10 c.c. Boats, 500 yd.
1. W. Everett (Victoria), *Nan*: 56.1 m.p.h.
2. S. Poyser (Victoria), *Rumpus* 3: 54.9 m.p.h.

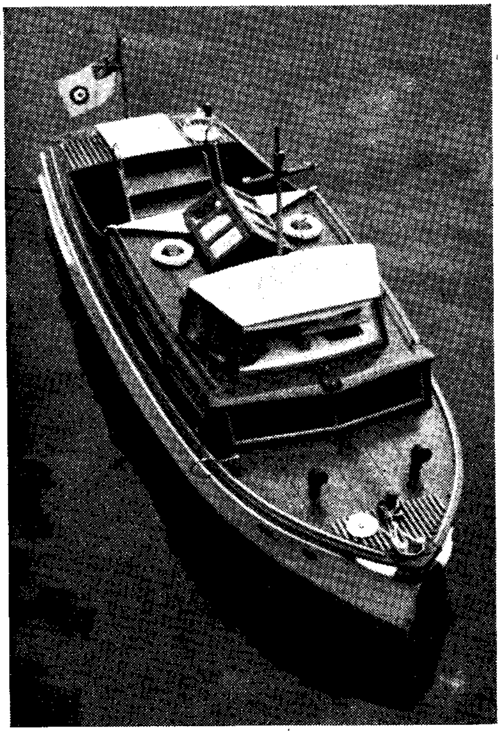


Mr. J. H. Benson (Blackheath) with his "A" class boat "Orthon"



A varied group of prototype boats at the Bedford regatta

Some of the competitors in the prototype events



A new radio-controlled cabin cruiser by Mr. Emery (Bedford)

Newman Lowke Cup, 30 *c.c. Boats*, 1,000 *yd.*
1. J. H. Benson (Blackheath), *Orthon* : 49.53 m.p.h.
2. J. Innocent (Victoria), *Betty* : 48.01 m.p.h.

The Bedford M.E.S. Regatta

This annual event is another regatta that is set in very pleasant surroundings, and again it attracted large entries. The Victoria Club arrive en masse with a coach and lorryload of boats, competitors, and friends, which helped to swell the attendance considerably. The St. Albans Club was also strongly represented, and altogether eleven clubs participated in the regatta. A full programme of events was held, including nomination and steering for the straight runners. The Steering Competition was won by A. Clay (Blackheath) with *Elizabeth*, over a very tricky course on which many boats failed to score. J. B. Skingley (Victoria) was a joint second with *Josephine*, tying with A. Evans's *Moiety*. The fine prototype boats of the Victoria Club caused much interest among the large crowds of spectators gathered at the lakeside.

High speeds were attained in the racing events, and practically all the winners exceeded 50 m.p.h. Some were nearer 60 m.p.h., for example, R. Phillips's *Foz* 2 now back on form again, and J. H. Benson's *Orthon* which achieved the best regatta performance to date.

Good runs were made in the Class "B" race by several well-known boats, and the winner was again J. Rose (Coventry) with *Meteor I*. The famous flash-steamer—Frank Jutton's *Vesta* 2, again covered a few laps at very high speed, but the slowing troubles still persist in spite of constant experiment.

The Longholme lake has been much troubled with weed this year, and Bedford members spent two week-ends prior to the event in clearing operations. Their efforts were well rewarded by the success of the regatta.

Results

Class "D" Race, 300 *yd.*
1. K. Hyder, *Slipper I* : 35.7 m.p.h.
2. W. Everett, *Nanette* : 31.3 m.p.h.

Steering Competition
1. A. Clay (Blackheath), *Elizabeth* : 6 pt.
2. { J. B. Skingley (Victoria), *Josephine* : 5 pt.
   A. Evans (Victoria), *Moiety* : 5 pt.

Class "B" Race, 500 *yd.*
1. J. Rose (Coventry), *Meteor I* : 51.1 m.p.h.
2. L. Pinder (S. London) : *Rednip* 7 : 48.7 m.p.h.
3. S. Poyser (Victoria), *Rumpus* 4 : 46.1 m.p.h.

Nomination Race, 50 *yd.*
1. A. Evans (Victoria), *Moiety* : 3.3 per cent. error.
2. G. Jones (Victoria), *Fidelis* : 5.83 per cent. error.
3. J. Curtis (Victoria), *Micky* : 7.00 per cent. error.

"C" Restricted Race, 500 *yd.*
1. S. Poyser (Victoria), *Rumpus* 3 : 56.8 m.p.h.
2. W. Everett (Victoria), *Nan* : 45.2 m.p.h.

Class "C" Race, 500 *yd.*
1. R. Phillips (S. London), *Foz* 2 : 59.4 m.p.h.
2. J. H. Benson (Blackheath), *Moth* 2 : 29.2 m.p.h.

Class "A" Race, 500 *yd.*
1. J. H. Benson (Blackheath), *Orthon* : 57.5 m.p.h.
2. J. Ward (Orpington), *Kali* : 53.2 m.p.h.
3. J. Innocent (Victoria), *Betty* : 52.3 m.p.h.

The Model Power Boat Association

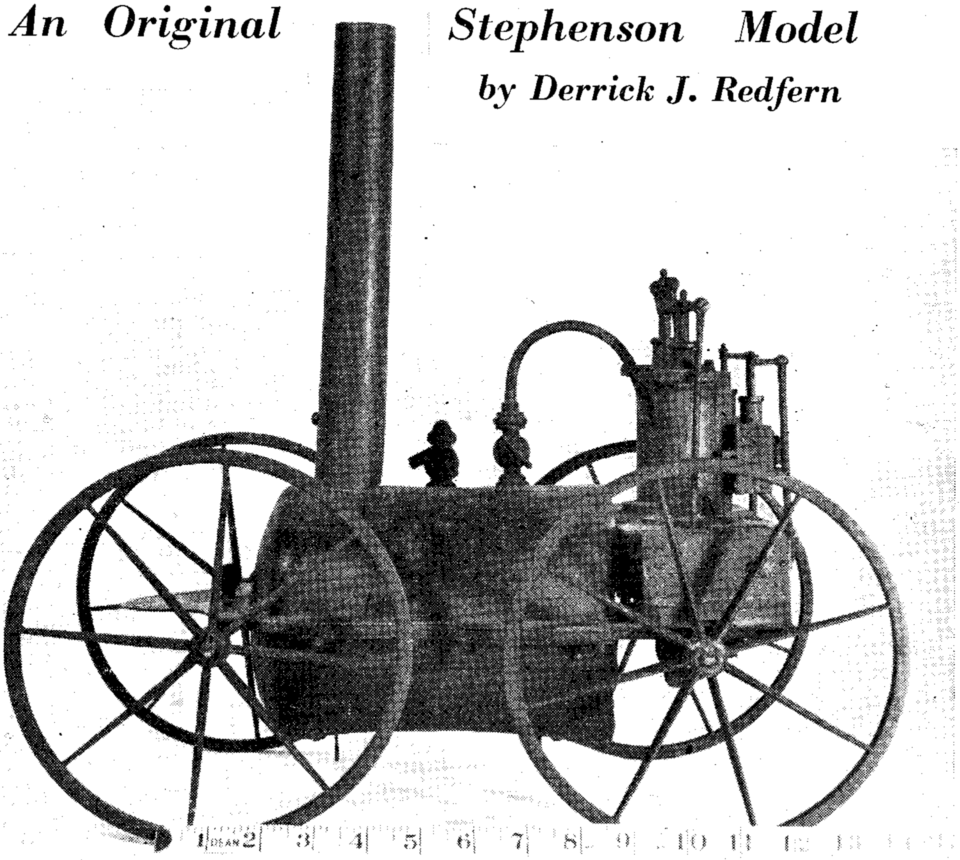
The 1952 Model Power Boat Association Grand Regatta will be held at Victoria Park, Hackney, London, E., on Sunday, August 31st, commencing at 10.30 a.m.

Events will be in the following order :—

(1) 75 yd. Nomination Race.
(2) 500 yd. race for the E.D. Trophy—"C" (Restricted).
(3) 500 yd. race for the Mears Trophy—"B" Class.
(4) Steering contest for the M.P.B.A. Steering Trophy.
(5) 500 yd. race for the Victory Cup—"C" Class.
(6) 500 yd. race for the Speed Championship Cup—"A" Class.
(7) The Crebbin Trophy for the fastest flash steamer.
(8) Prototype competition for the "M.E." Cup.

An Original Stephenson Model

by Derrick J. Redfern



THE accompanying photographs were taken of an historic and unique engine that has been seen a number of times at local exhibitions, and will be, I am sure, of interest to all model engineers. It is the property of Mr. A. F. Smith, of Matlock, a keen model engineer, and has been in his family for generations.

It is a model of a travelling engine made by George Stephenson, and was evidently constructed either as an experimental or as a demonstration model. Mr. Smith assures me that there used to be in his family a large parchment giving specifications of the model, but this appears to have been mislaid. It is known, however, that the model was made prior to a successful trial with a travelling engine named *My Lord*, at Killingworth Colliery, on July 25th, 1814.

Unfortunately, in the first world war, it was taken by a "fitter" employed by Matlock Tramways, who intended to make it run. He failed to do this, but he did manage to desecrate the original by the addition of two gas taps on the boiler, clearly seen in the photographs.

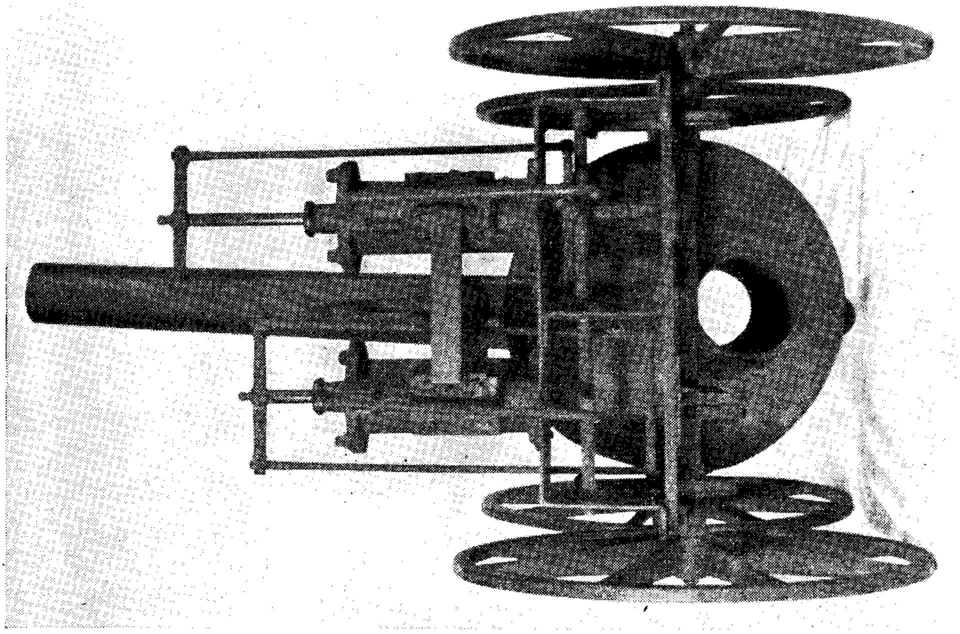
As regards the model itself, it is made of brass, except for the boiler which is of copper, and the crossheads, eccentrics and axles which are of iron. All the original screws are square-headed with a screwdriver slot diagonally across the top, and with a thread that cannot be classified.

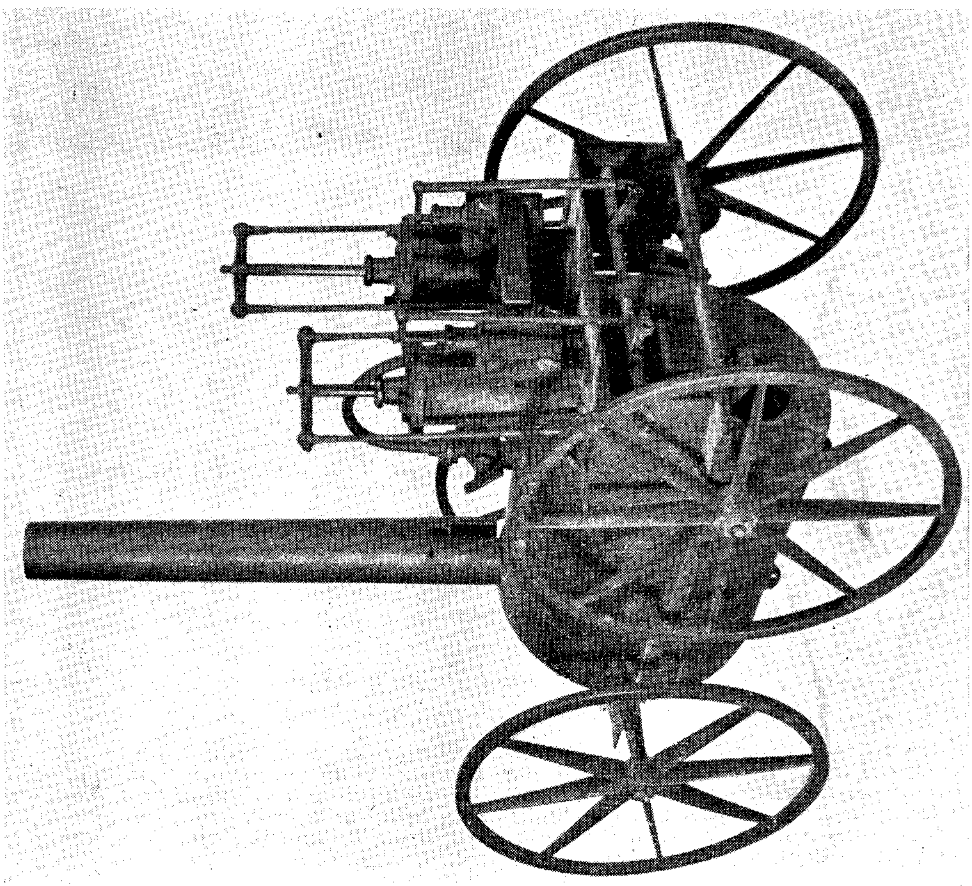
The boiler is interesting in that it has running through it from front to rear under the frame, a hole approximately $1\frac{1}{2}$ in. in diameter, into which fitted a large iron rod rather like a clock weight. To raise steam, hot water was put into the boiler through a funnel over which the chimney fits and to which it is held by three screws. The iron rod which meanwhile had been heated to a red heat in a fire was pushed into the hole and a good head of steam raised in a few minutes. As a boy, Mr. Smith did this frequently. At the rear of the boiler underneath the cylinder platform are two trycocks, approximately $1\frac{1}{4}$ in. apart, vertically.

At the back of the chimney just over the funnel is a hole which suggests an inlet for a pipe; but it cannot be for the exhaust, as there is no provision on the steam chests for exhaust pipes. The cylinders exhaust direct into the atmosphere.

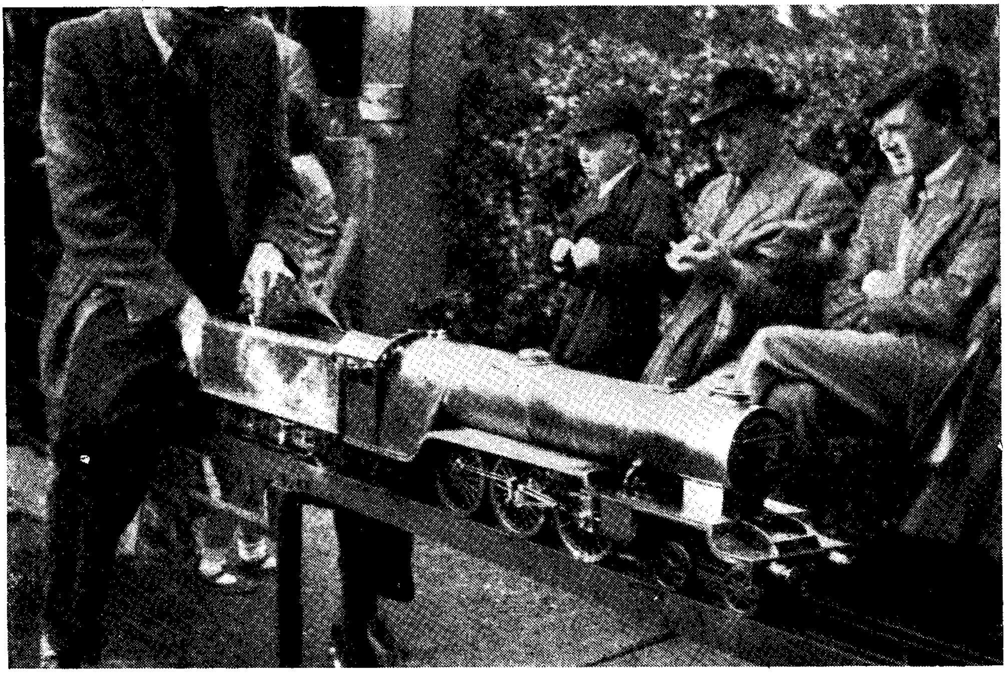
The valves are operated *via* eccentrics operating two rocker shafts in the same line, one working in the end of the other. Two gab-ended rods from the rocker shaft operate the valves. The

(*Continued on page* 284)





York Entertains



ON Sunday, July 13th last, York City and District Society of Model Engineers opened their multi-gauge locomotive track at Bishopthorpe, near York, to the public.

The bulk of the running was done by Mr. Eric Sedman's $3\frac{1}{2}$-in. gauge "Juliet." It is amazing where this engine's power and speed comes from, as it scoots round the track at high speed with driver and four kiddies.

The track is an oval of 385 ft. circumference with 40 ft. radius curves, and is situated in an orchard giving very pleasant surroundings. An L.M.S. tank engine by Mr. Tyson did very good work without fuss. This engine is a magnificent three-cylinder job, fitted with steam atomising oil burner consuming paraffin, and is remarkably clean to handle.

Mr. "Bill" Shearman's 0-6-0 N.E.R. tank engine in $3\frac{1}{2}$-in. gauge did useful work until retired with crosshead adrift from piston-rod, and as this model has inside cylinders with valves between, repairs could not be carried out at the site.

The society had the pleasure of welcoming visitors from the Harrogate Society and the York Miniature Railway Society. Mr. Tassle, of the former club, brought along his incomplete "Hielan' Lassie" and put in some good running. (See photo above.) His initial slipping trouble gradually disappeared as the wheels bedded down.

Mention must be made of the wonderful efforts of "passenger manager" Mr. George Headley, who carried right through to 9.15 p.m. with scarcely any break. Also, special mention is needed of the good service rendered by junior member Peter Smallwood who kept the locomotives supplied with fuel and water.

A hearty cheer is due to Mrs. Sedman who looked after the thirsty needs of drivers and staff. The weather was glorious and over 300 people passed through the gate, and everybody thoroughly enjoyed themselves.

An Original Stephenson Model

(*Continued from page* 282)

cylinders of 1 in. bore and $1\frac{3}{4}$ in. stroke are set vertically on the platform at the rear of the boiler and operate the crank by means of side-rods clearly seen in the photographs. Steam is led from the boiler to a rectangular steam manifold which screws to the face of each steam-chest.

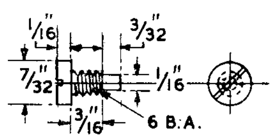
Only the right-hand wheel is driven, and all wheels are of the carriage type, beautifully made. The front pair look as though they were originally fixed, but are now allowed to swivel on a central pin. There also appears to have been a platform at the rear, as there are several rivets in the rear cross frame.

A Carburettor for the "Busy Bee"

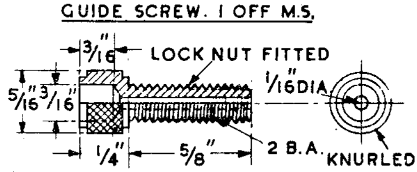
by Edgar T. Westbury

THE remaining components for the carburettor are small, and simple to produce, but not by any means insignificant. In the case of the guide screw for the throttle, it will probably be found just as quick, and certainly far more satisfactory, to make this outright, as to attempt adapting a standard 6-B.A. screw by turning down the end. It should be noted that this screw must be removed for assembling the throttle plunger, which will usually be found easier than having to "feel" for the locating pin or key while inserting the plunger and aligning the jet needle at the same time, as in the majority of motor-cycle carburettors. The screw should not project through the barrel so that the threaded part binds against the throttle plunger, but if this should occur, it can be remedied by putting a spring washer under the head.

The cable adjuster is of standard type, and I believe that it can be obtained ready made, but my experience is that one can make these and similar items much quicker than trying to explain what they are to salesmen who have "never 'eard of 'em!" They are sometimes made with a hexagonal head, and this, of course, is optional, but I have found a knurled head more convenient, the lock-nut, however, being hexagonal to enable it to be properly tightened.



GUIDE SCREW. 1 OFF M.S.

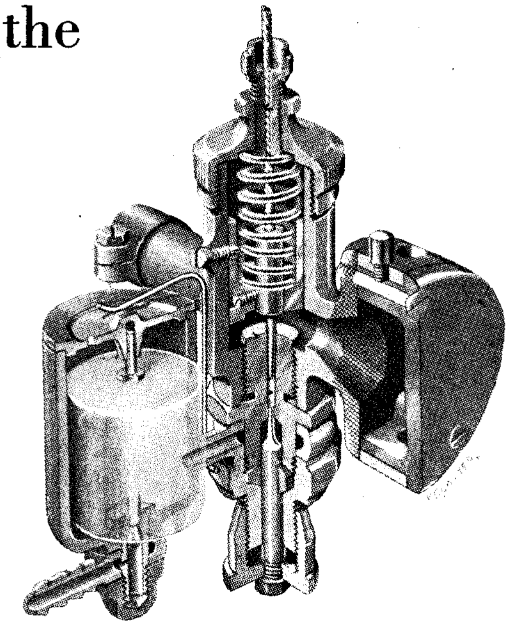


CABLE ADJUSTER. 1 OFF BRASS

Float Chamber Clip

There are many possible ways of holding on the lid of the float chamber, and all of them have been used more or less successfully in standard carburettors. The wire clip shown is simple to make and quite secure in use, enabling the cover to be removed by springing the ends upwards and outwards, but no claim is made that it is original, or has any special advantages over other devices for this purpose, so this also is optional.

Continued from page 223, "*M.E.*," *August* 14, 1952.



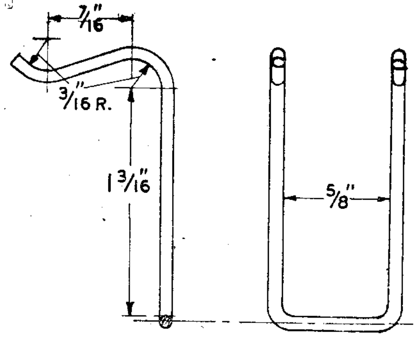
The "Busy Bee" carburettor in part section

Alternative Jet Arrangements

As previously mentioned, constructors who do not wish to adopt the form of variable jet specified can use either a fixed or pre-set jet, as shown in the illustrations herewith. The former uses a standard commercial type of jet, which is screwed 4 B.A., and the lower end of the jet housing is counterbored to take the head. It is important that the end of the counterbore should be flat and true, as any leakage at this seating will affect the jet calibration, and it is not very convenient to fit a washer or other packing to so small a jet. The orifices of these jets are generally calibrated in cubic centimetres per minute under a standard "head" or pressure; the larger the number, therefore, the more fuel they pass. Sizes from about 24 to 30 will usually be found to cover the range required for 50 c.c. two-strokes. If the jets are home-made, the orifices should be drilled from about 0.008 in. to 0.012 in. dia. and broached with a suitable needle broach.

In the second alternative form of jet, the orifice is made as specified, and is also varied with a taper needle, but adjustment is only possible by removing the cap-nut, and once set, is locked by means of a nut on the screwed needle. This cannot, of course, be adjusted while the engine is running, but it may be preferred by users who have friends anxious to help in improving the "tuning" of the engine!

There is little in the assembly that calls for any explanation, as the relative positions of the components are fairly obvious, and there should be no fitting required if they are made to specified dimensions. No allowance has been made for fitting washers or gaskets between any of the joint surfaces, as I have found these more trouble than they are worth, being liable to get lost or



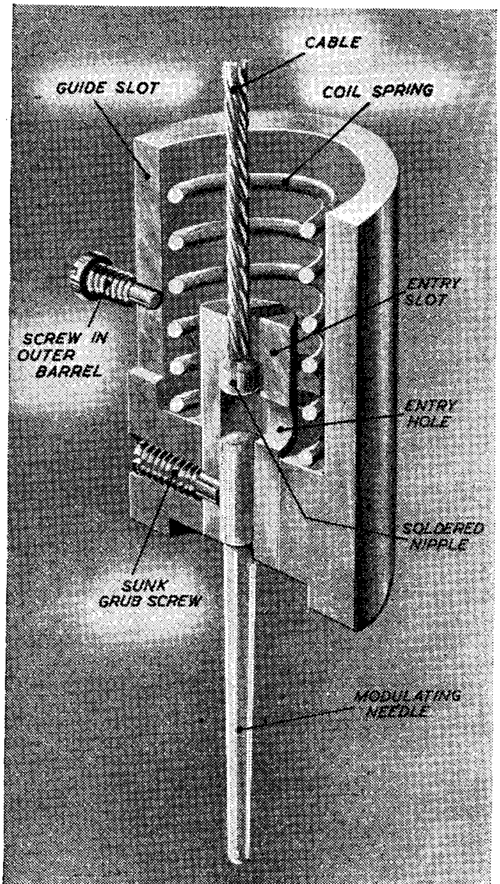
FLOAT CHAMBER CLIP
1 OFF 16 S.W.G. PIANO-WIRE

squeezed out, always in circumstances where they are not readily replaceable. It is quite easy to ensure tight metal-to-metal joints, by reasonable care in machining, and using keen tools.

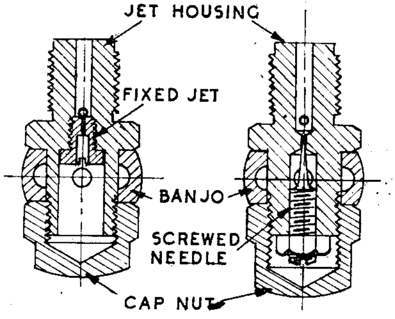
Take the utmost care to ensure that all passageways are perfectly clear before assembly, and syringe drilled passages with petrol to remove the least traces of swarf, metal dust, or fluff, which are capable of causing endless trouble if left in the system. One constructor who complained vehemently about the behaviour of a carburettor of my design, was found to have omitted to drill a small but very essential hole in the air bleed system!

The best way to make the gland packing for the jet needle is to cut a small cork down, by paring and glasspapering, till it can be forced into the top end of the gland housing, and part off about a $\frac{3}{16}$ in. length with a razor blade. Screw the gland housing on to the jet housing just tight enough to clamp the cork, and run a $\frac{1}{8}$-in. drill through the latter. It will now be found that when the gland housing is assembled in place, with the jet needle in position, the packing is perfectly petrol-tight, and will remain so indefinitely. Be careful to remove all the cork dust from the system.

When fitting the carburettor to the inlet stub of the engine, make sure that the latter is smooth and accurate, with the end face machined square, and that it makes contact with the face of the recess in the bore of the carburettor throat when pushed fully home. A smear of joint varnish on these surfaces, and also those of the jet and fuel inlet joints, is helpful as an insurance against leaks, but should not be regarded as an absolute necessity. Remember, however, that an air leak will upset the best-laid schemes of mice and men when it comes to adjusting a carburettor, and take due precautions against it accordingly.



Section through throttle plunger, illustrating method of securing modulating needle, and attaching Bowden cable



FIXED JET PRE-SET JET

Adjustment

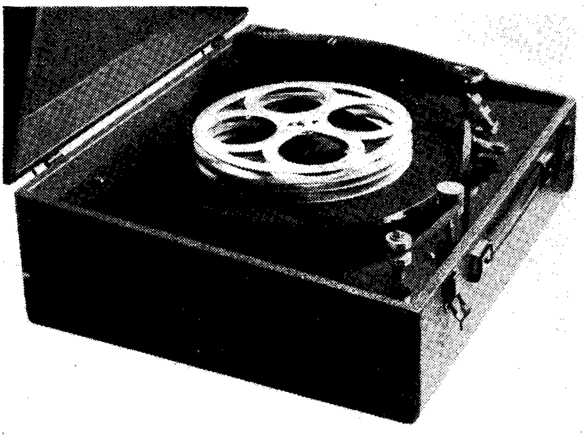
The initial adjustment should be made with the throttle about one-third open. Adjust the jet so that the engine two-strokes evenly under load, trying the effect of slight increase and decrease of richness under actual working conditions if possible. Now open the throttle wider and note whether the mixture tends to become richer or weaker, checking this by altering the jet setting if necessary, so long as a note of the initial setting is kept. If the tendency is to weaken off at full throttle, the taper on the needle is too slight, and

(*Continued on page* 288)

A SIMPLE TAPE RECORDER

by G. R. Judge

How a gramophone turntable may be adapted to provide motive power for the tape reels



The simple tape recorder—erase-head not fitted

RADIO has tended to make people indolent to the extent of it being too much trouble to put on a record, with the result that many a good gramophone stands idle. Therefore, conversion to a modern magnetic tape recorder should be considered.

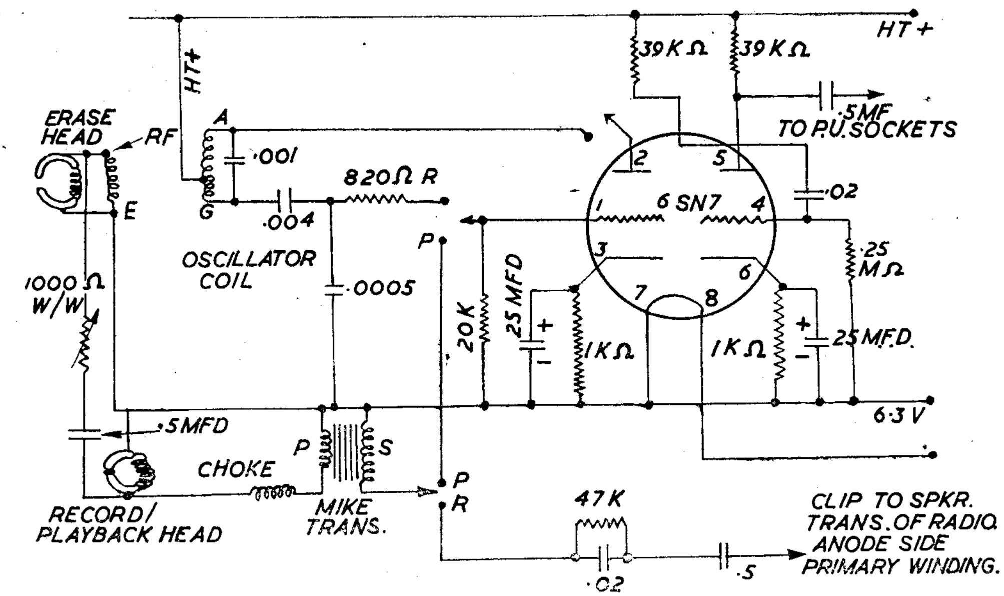
If we put an empty tape spool on to a gramophone turntable and catch to its centre the end of a full spool of tape, the tape will be pulled on to the empty spool when the motor is switched on. For smooth running, the full spool of tape will need to be poised on a spindle, and it will be found that it revolves faster and faster as the diameter of the mounting-up tape increases on the empty spool on the turntable. More often than not this increasing speed causes the tape to spill and entangle. By extending the centre stub of the turntable, however, the two spools can be accommodated one above the other, and both will revolve with the turntable. If we arrange the tape on the top spool to be pulled off from the left-hand side, not only will the spool not be able to revolve in sympathy with the turntable, but its desire to do so will keep the tape taut. Now, if we can arrange to feed the tape back on to the bottom spool, the tape will pass smoothly from the full to the empty spool. To do this, the tape is guided around two roller guides and across the face of the recording/play-back head. With this arrangement a spool of tape of 1,200 ft. will make and replay a recording for about a quarter of an hour, and the quality can be as good as that of a quality record or a B.B.C. recording.

So much for the mechanical conversion. There now remains to be made a small add-on unit for one's radio or radiogram chassis. It has been known for a long time now that louder and better quality recordings can be made if at the time of recording *via* the output of a radio or gram. chassis there is injected into the sound a heterodyning current of about 45 Kcs frequency, and this same current also serves to erase magnetically those recordings no longer needed. The easiest way to make this unit is to build a one-valve oscillator; as a guide to this the theoretical circuit is given herewith. To check this oscillator unit when made for correct functioning, make a loop about the size of a penny from thickish tinned copper wire (if none is handy, a piece of flex will do as well). The two ends of the loop should be soldered, one to the pimple of a torch bulb and one to the screwed nickel shell of the same. If this loop is placed near the oscillator coil, the bulb should glow, thus proving that the oscillator coil is generating.

It will be noticed upon analysis of the circuit that the recording-head is energised *via* a clip from the radio's output transformer.

If you wish to record matter other than radio programmes, then a gramophone pick-up or microphone can be plugged into the P.U. sockets of the chassis. To replay the recording, the switch on the oscillator chassis is switched so that its output can now be plugged into the P.U. sockets of the radio chassis and the recording amplified and heard from the loudspeaker. To ascertain the correct amount of heterodyne current to inject into the head when recording, make notes and set the position of the regulator control to zero and then advance one notch and speak (read) for one minute; then, with the tongue in the cheek, make a noise like geeing up a horse, Tsk! Tsk! This easy distinguishing noise indicates the end of a reading. Now move to notch two and repeat, and continue in this fashion until the complete traverse of the regulating control has been covered. If the recording is played, one can now decide the best minute's recording, and thus know at what position to set the regulating control.

Erasure of previous recordings is automatically



cared for. When recording, the tape first passes over the erase head and is thus cleaned preparatory to receiving a recording from the recording-head. When the recording is replayed, the erase-head is automatically switched off, thereby not interfering with the recording on the tape. To rewind, the spools are simply placed about, thus passing the tape back to the original spool.

A Carburettor for the "Busy Bee"

(*Continued from page* 286)

should be increased ; and the reverse, of course, applies if it tends to become richer under these conditions. Alterations, if found necessary, should be made by easy stages ; under certain conditions, departure from a constant angle of taper may be found desirable, but this is not usual for normal engines on moderate duty.

At the smaller throttle openings, the cutaway of the throttle plunger has a pronounced effect. If the mixture tends to become very rich when the throttle is nearly closed, the amount of cutaway may need to be increased. It is not always easy to judge this properly, as nearly all two-strokes tend to "four-stroke" when running slowly, particularly at light or no load, but this should not be confused with the effects of rich mixture, which are likely to cause surging or "hunting," excessive blue smoke, and a tendency to oil up plugs. Reluctance to start at low throttle openings when the engine is warm is often encountered.

The effect of the air bleed on carburettor adjustment is often found difficult to assess, as an alteration of the air bleed orifice may make no perceptible difference under stable working conditions. It does, however, make itself felt under changing load conditions, reducing the tendency of the engine to stall when overloaded, or to race away when load is removed. There should be no need to experiment with the size of the air bleed orifice, but if any alteration is made it will influence the function of the modulating needle, the taper of which may have to be increased if the orifice is enlarged.

It cannot be denied that carburettors, and small ones in particular, can be baffling things at times, and to get the best results from them demands patience and perseverance, not to mention a modicum of what is colloquially termed "common savvy." Older readers who may have had to wrestle with the intricacies of the fearfully and wonderfully conceived carburettors of the past (some of them having up to twelve jets !) will agree that tuning a modern carburettor is child's play. The working conditions of an auto-cycle carburettor are not exacting, as a "flat spot" or even a stall demand nothing more than what the ancients used to call "L.P.A." (light pedal assistance), but it is infinitely better if the engine is always on top of its job and does not have to be nursed under any conditions.

To those of my readers who have reminded me that a carburettor is not complete without its control lever, I would mention that this point has not been disregarded, and I shall be describing a specially designed dual-action control, to suit the "Busy Bee" or other auxiliary engines, right away.

WHY NOT A DIAPHRAGM CHUCK ?

by "Base Circle"

THE diaphragm chuck is not very generally known among model engineers and other home users of the lathe. Even where it is known it is usually looked upon as purely a production tool and quite unsuitable for "one off" jobs such as amateurs usually encounter. Yet nothing could be further from the truth. A properly designed diaphragm chuck fitted with a convenient means of setting for varying diameters can be a most useful appliance. It is used in factories for work where the highest degree of accuracy is called for. Indeed it affords the means of maintaining on the larger diameters the same standard of accuracy which the collet chuck provides in the case of small work. Suppose, for example, we have an accurately finished bush whose bore we wish to enlarge or a bush finish turned on the outside but still to be bored. Just imagine how difficult and exasperating a job it can be to true up the bush sufficiently well to give even a reasonable chance of concentricity. Some workers would possibly use the three-jaw scroll chuck and hope for the best! But even the best of scroll chucks cannot be relied on for anything closer than about 0.005 in., and I fear that many of us are using chucks which don't come anywhere near the category of the "best." With the independent chuck, a dial gauge, and plenty of patience, better results would be obtained. On the other hand if a diaphragm chuck is available the job is simple.

A general arrangement of the chuck is given in Fig. 1. It will be seen that the backplate is screwed to the spindle nose in the usual way. To it is held—by eight screws—the chuck body. This consists of a thin cast-iron plate (hence the name diaphragm) cast solid with a ring of metal which is split right down to the surface of the plate to form projecting segments. Through each we have a $\frac{5}{16}$-in. screw locked by a grub-screw as shown. These $\frac{5}{16}$-in. screws form the adjustable and renewable jaws of the chuck.

The principle of the chuck is illustrated in Fig. 2. Here we have the operating screw which passes right through the lathe spindle and screws through the backplate. The end of the screw butts against the diaphragm and springs it forward—the diagram exaggerates the amount of movement very greatly—the actual movement necessary is very slight. In this position the jaws are open and the part to be operated on can be inserted. The screw is then withdrawn, allowing the part to be gripped by the natural spring of the cast-iron. The grip will be found to be more than ample for all ordinary operations.

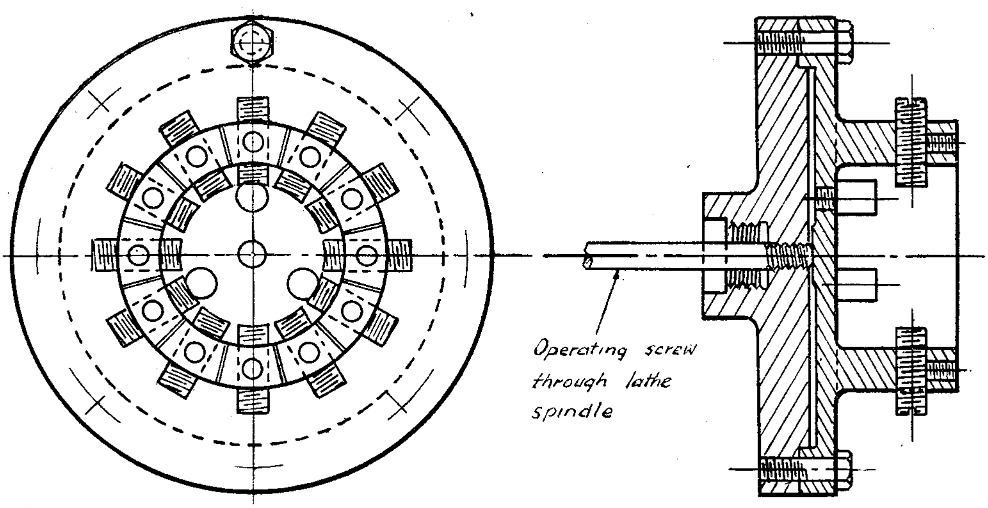


Fig. 1. Arrangement of chuck

The procedure in using the chuck is to adjust the jaws to slightly under the diameter of the part to be held. Having locked them securely, the operating screw is advanced very slightly—the correct amount will soon be found by practice. In this position the jaws should be skimmed out to fit the job, using a sharp tool and a light cut. At the same time the end stop screws should be dressed up. It will be apparent that if we now insert the job and release the operating screw, the part will be gripped absolutely truly. The accuracy of chucks of this kind is so great that they are regularly used for holding gear wheels for automobiles by the teeth—that is on the pitch-line—while the bores are ground. For such work, accuracies of tenths of a thousandth are essential.

The details of the chuck are given in Fig. 3,

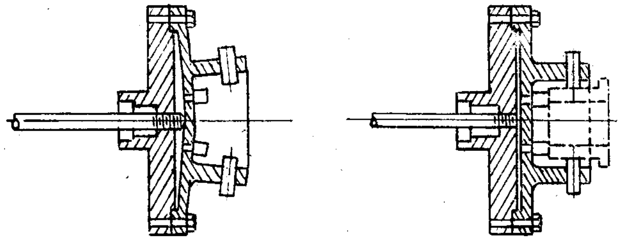


Fig. 2. Diagram showing operation of chuck

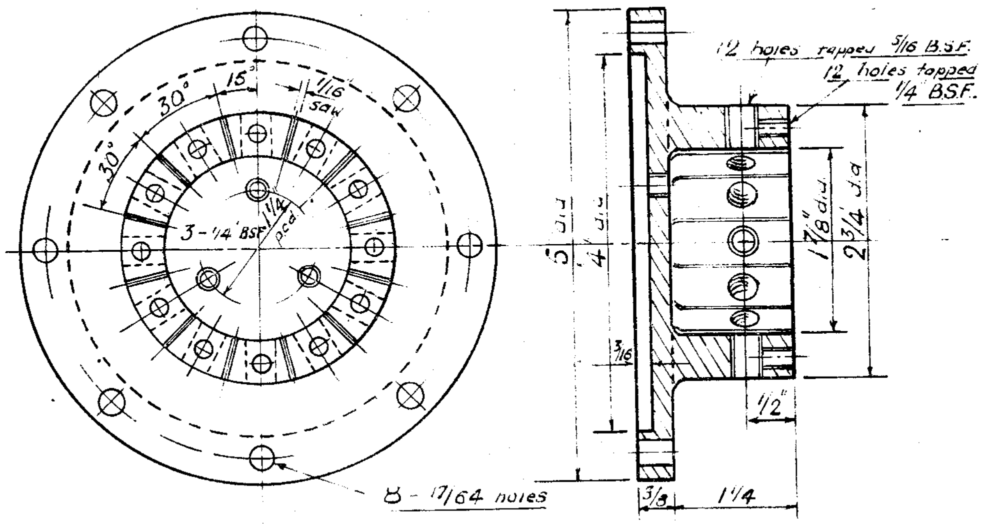


Fig. 3. The chuck body

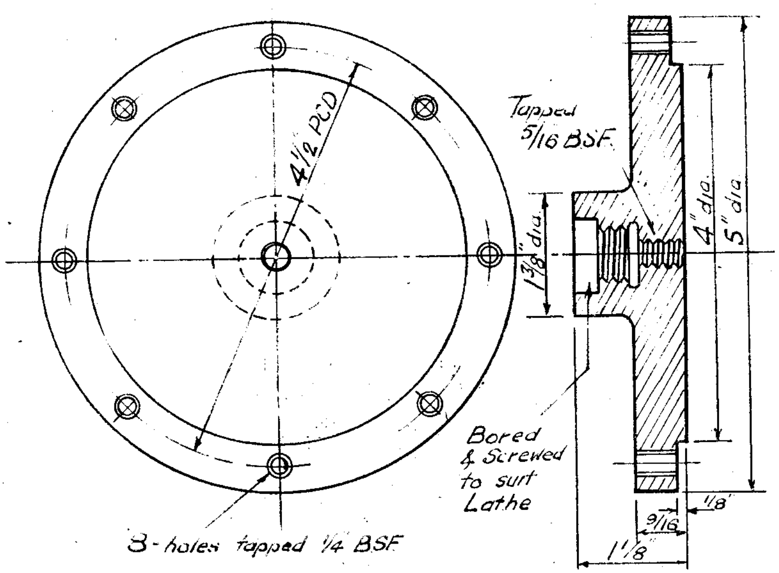
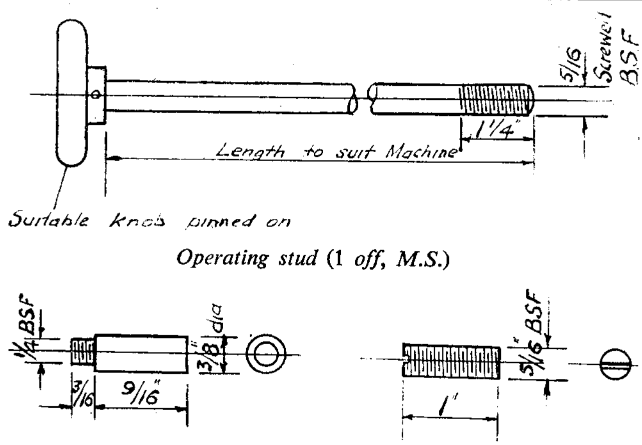


Fig. 4. Backplate (1 off. cast-iron)



Operating stud (1 *off, M.S.*)

Stop pin (3 *off, M.S.*) *Adjusting screw* (12 *off, M.S.*)

Fig. 5. *Details*

4 and 5. The job is a fairly straightforward one and should not present any serious difficulties. The dimensions can be modified to suit the size of work likely to be handled.

The same type of chuck can readily be adapted to grip internally to allow of outside diameters being turned. To do this the operating screw must be arranged to pull the diaphragm back instead of pushing it forward. The stop-pads would be outside the jaws instead of inside. It will be seen that if we dress up the jaws to the required size while the diaphragm is retracted, then they will grip the bore of the job and hold it truly when the screw is released.

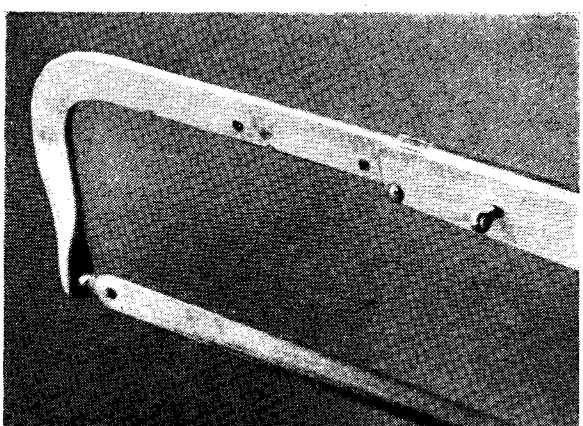
Where the lathe to be used is not provided with a hollow spindle, a chuck of this kind can still be used. So long as hollow parts such as bushes are to be catered for only, it is quite easy to arrange for operating the chuck by means of a screw manipulated by a screwdriver from the front.

There is one other great advantage of this chuck over the usual three-and four-jawed variety. That is that owing to the number of gripping points, there is much less danger of distortion when dealing with thin-walled parts.

A Hacksaw Improvement

by C. T. Bower

THE extensible hacksaw frame for accommodating various blade lengths is a useful tool, but is an abomination when it is desired to change blades. When no blade is held in the frame, the whole assembly collapses and about two pairs of hands are required in order to hold the frame rigid while the blade ends are hooked over the mounting pins.



I modified my hacksaw frame in the manner illustrated in the photograph, by drilling a hole to take a split-pin, right through the fixed and sliding portions of the saw backbone. With the pin inserted, it is impossible for the frame to "jack-knife" when changing blades.

When drilling the frame, first extend the frame to the position it assumes when holding the longest blade, then drill through, placing the hole near the end of the sliding portion. Holes can be drilled to suit other blade lengths by adjusting the frame to the required positions and pushing the drill through the existing hole in the fixed portion. Open the legs of the split-pin only sufficient to prevent the pin falling out, but so that it may be pulled out by the fingers.

This improvement is soon done and saves hours of juggling with loose saw parts.

TWIN SISTERS

by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally but very different internally

IT is easy to take things for granted ; one of the things I took for granted was the fact that when drawing, one had to bend over a drawing board. The day came when I found that I could no longer bend, and when that fact was digested, something had to be done about it, and done quickly. The only solution appeared to be the fitting of a drafting machine that could be set at such an angle that work could be carried out, not only seated, but partly leaning back if necessary.

Eventually, an easel was set up with a counter-balanced board to cover every working height ; further adjustment was added to give a wide range of tilt, and a first-class drafting machine acquired. This was made to work only in the flat plane, and a further set of balance linkage had to be added until the protractor-head would stay in any position without moving.

Doing the first drawing was a bit strange, and apart from getting a new brand of neck ache in the process, it was found that drawings could be turned out with much less fatigue than with the normal board and set-square. It was also refreshing to handle a British-made product in the modern idiom that lacked nothing in finish and workmanship.

Cylinder Drain Cocks.—System 2

Without too much repetition, this drawing gives the general layout, with full information regarding the master cock itself.

The cylinder fittings are simple banjo unions of the type I always use when short of space. In spite of what has been said about them, they are less prone to leakage than any other type of union ; needless to say, they must be made with reasonable care, and if the banjo portion is drilled out, recessed, formed on the outside and parted off, and which to me seems to be the only reasonable way of making them, the two faces can hardly fail to be parallel with each other. *That* is the one condition that will ensure their leak-proof condition indefinitely. On this master cock system, it is rather more important that they *should* be leak-proof, because a moment's reflection will show that they are under pressure more or less all the time, and not cut off from boiler (or cylinder) pressure by a plug cock above it. The four pipes that lead to the master valve, situated in the middle, are, therefore, "live," and a single disc-valve having four ports and four drilled holes to match, opens and closes the entire system.

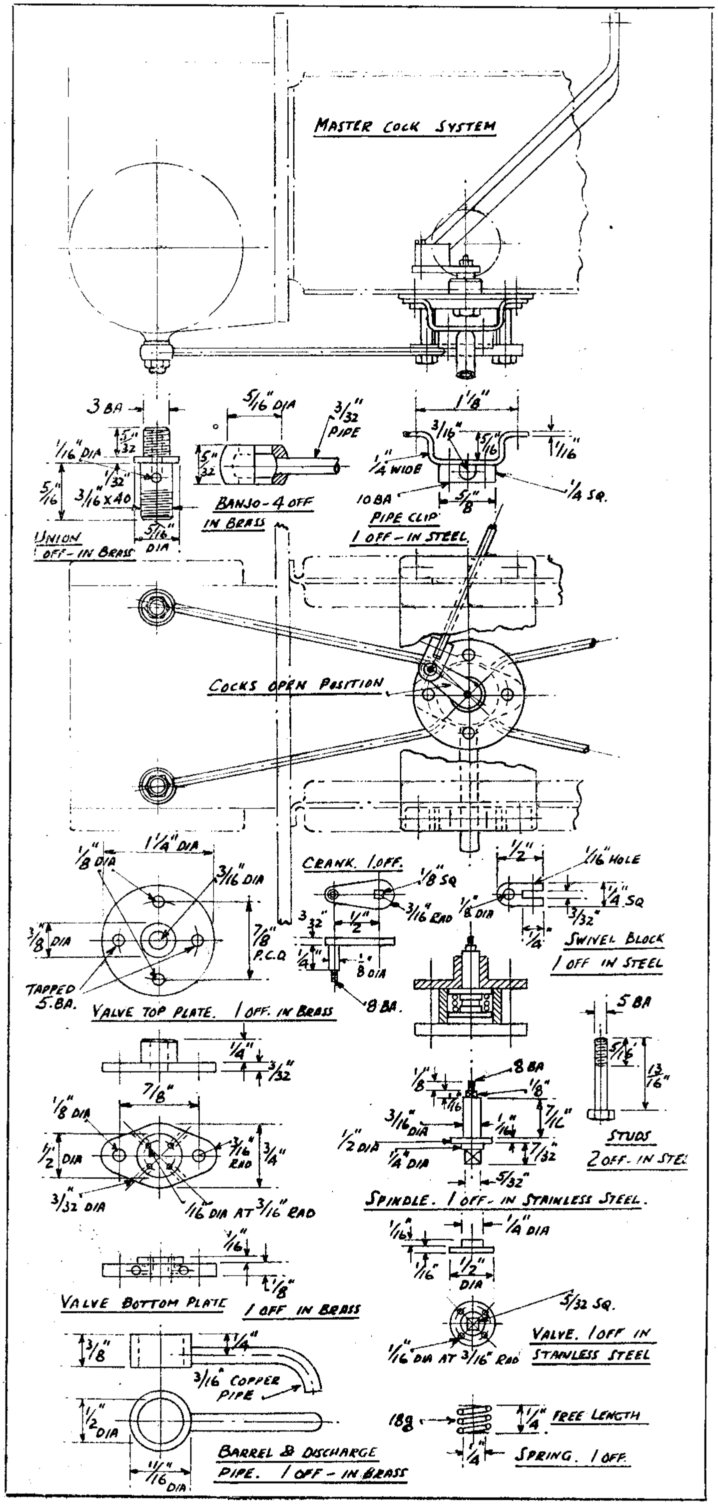
Since the drawing was completed, I have made two slight alterations when making up the parts, but these are simple enough and I can explain them. The actual disc-valve is shown with four holes drilled in it, and a central square hole to take the drive from the spindle ; here is a case where the square hole is left slightly slack in fit to allow the disc to find its own level on the seating. Around this disc I have filed away a little of the edge and fitted a tiny stop peg in the bottom seating ; this gives a definite "on"-"off" range of movement, and is helpful when setting up the valve on the chassis, and it is no longer possible to see the position of the disc inside the assembly. I like the disc type of valve because it is possible to lap down both valve and seating on a slip or grindstone, to ensure steam tightness—an operation that takes little more than seconds to carry out. Do this before fitting the stop peg, but drill the hole for the peg first, and the flat surface of the seating will not be upset.

The drawing also shows a single pipe leading from the valve body, to a discharge position forward. On the prototype, the pipes are led inwards and forwards, all to discharge in a central group just as we have them. In my case, liking exact detail rather a lot, I fitted four small pipes together from the body so that the external appearance is perfectly correct, and if you wish, you can do the same.

The spring fitted to hold down the disc-valve, is very necessary. Here is a case where the pressure tends to lift the valve off its face, and in that sense, makes it an automatic release-valve as well ; to make it work as such would entail some experimenting with springs strengths because the spring shown would be far too stiff. If the engine had been fitted with piston valves instead of slide valves, I would have suggested making use of this feature ; but, as it is, there is very little advantage to be gained from the "automatic" feature. Here is a chance for "Minor" builders to fit a type of master valve with just a plain, undrilled, spring-loaded disc over the four ports, much on the same lines as the manual valve but without crank and spindle ; once again, only a light spring would be needed.

The final linkage back to the cab would be much on the same lines as the former four-cock system. You will find that the big round hole in the No. 2 stretcher is more than enough to pass the bent rod, and to provide for the swinging movement of the crank. Ultimately, there will be a slotted bracket fixed to the back end of the side tank. Through this the final rod will pass and a couple of slots cut on the under edge of the rod will determine the "on"-"off" positions, and hold them firmly. The rod, where it comes out in the cab, is turned down on edge, to simulate to some extent, an umbrella handle.

Continued from page 232, "M.E.," August 14, 1952.



The rest of the drawing should be self-explanatory, and slight variations in the manner in which the job is carried out, should not have any adverse effect on its working.

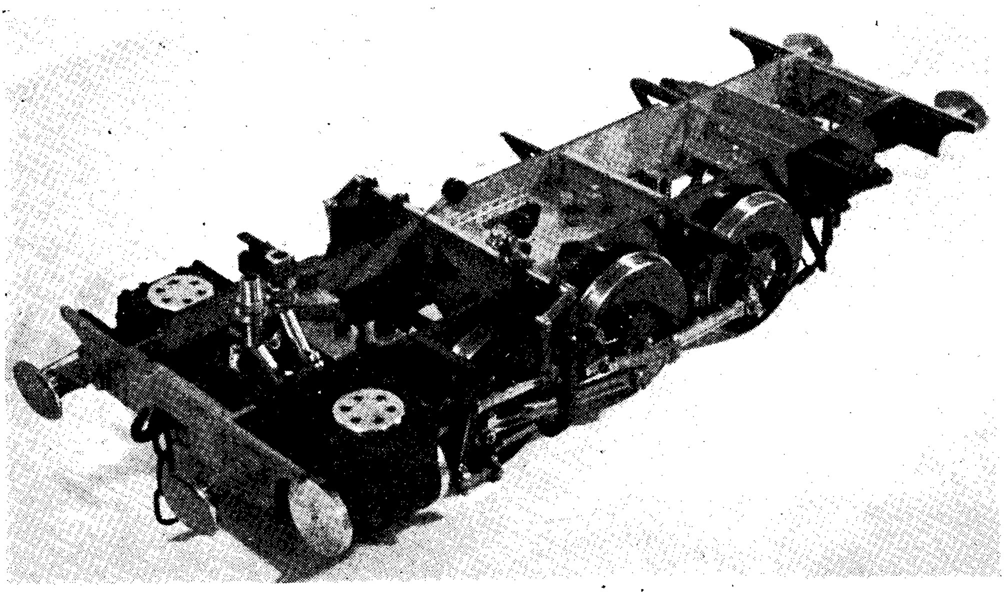
The Plot Thickens

I have come to realise that, if I am going to draw in every detail of every part of this engine, and leave not a single thing to your imagination, I shall never get going on anything else. I doubt very much if anyone will bother to put in some of the finer details, even if they are described here. Some features builders will not approve of ; others may be needed but hashed up in a different form ; in fact, there is just no end to it all. Take, for example, the main oil feed pipe from the lubricator to the cylinders ; I can give you all the information you will need, in writing, so here it is :

The main oil pipe runs from the left-hand side of the cab, direct from the sight feed lubricator glass. Now this oil pipe that runs forward to the cylinders, need not be large, say 3/32 in. It should run along near the top of the frames, and then dive down to a tiny "tee" fitting, right midway between the two cylinders. Make up a couple of clack valves to screw straight into the tapped holes ($\frac{1}{4}$ in. × 40) provided in the cylinder backs. These can be simple horizontal fittings, with $\frac{1}{8}$-in. steel or bronze balls, and *very* light springs to hold the balls in place. If this spring is made too strong, there will not be enough differential pressure to overcome the load of the spring, and if too light or of different tension, there may be a tendency for one cylinder to get more oil than the other. Normally, there is a difference of some 15 per cent. between boiler and steam-chest pressure, and we make use of that fact to secure a constant and even oil feed

at all times, and with the added advantage of being able to *see and control* the oil going through the system.

And now a word of warning ; fit the clacks the right way round ; that is, so that oil can enter the cylinder from the outside, but steam cannot blow back down the pipe, or across to the opposite cylinder. Finally, the hole in the clack fitting where it enters the back of the cylinder, should be very small, say anything between No. 65 to 70 drill—you may go even smaller if you like. The other end of the pipe should be tied up out of the way, and cut off long enough to allow it to come well up to the cab roof.



Showing Mr. Younghusband's excellent workmanship

Further Example

It gives me great pleasure to be able to publish another most successful "Twin Sister" in the making. This is the work of Mr. Younghusband, of Swinton, Manchester, and the picture speaks for itself. This engine, in its unfinished state won first prize in the appropriate section of the N.A.M.E. Exhibition at Manchester recently. This is the sort of workmanship I like to see, and will never get tired of seeing ; congratulations, Mr. Younghusband.

Progress Report

I have not yet let out of the bag, the exact position of "Twin Sister" No. 1. For those who are interested, she is at the moment standing with all boiler fittings and mountings finished, side tanks, running boards, cab and bunker in place ; it all sounds very much as though the job were finished—bar the shouting. It is only the "shouting" part that is keeping it from absolute completion now, and only those who have built a completely working detailed engine will appreciate how much goes into all the hundred and one tiny bits and pieces that have to go into place.

"Twin Sister" No. 2, now belonging to Mr. Edwards of Brighton, and being worked on by Mr. Hudson, also of Brighton, has had her first run. According to reports, Mr. Hudson had erected one side of the motion, and was testing her on air. After a slight initial push to get her over the single cylinder dead centre, she took to her heels, and galloped gaily across the workshop floor ; if she will do this when only *half* an engine, she ought to open a few eyes when completed. It is such a long time since I submitted "home" pictures of the "Twins," that I really must try to get some up-to-date shots for you to see.

And now, with the editor's permission, and with the "light duty" injunction in mind, I would like to go into the back-room and talk about other things.

I have had a busy week with Locomotive Insurance as one of the problems. Running on various tracks, public and private, and exhibitions of various kinds and in various places, everything has always gone smoothly, and records will show that *never on any occasion* has a fire gone out in the engine, or the water disappeared in the glass, except for a temporary stoppage due to dirty water, or some such cause. De-railed trucks were unheard of and accidents unthought of, and I have carried passengers at the steady rate of ten thousand per year for the last five years.

Somebody had the brilliant and sensible idea of making it essential to have a Board of Trade Certificate for the locomotive boilers, and with this I heartily and absolutely agree. To my mind, this should be absolutely compulsory,

and with a test pressure of at least three times the working pressure. But that is not all; to my surprise, the insurance company with whom I have always transacted my business, suddenly refused to insure me unless I fitted all passenger trucks with footboards having *continuous inside valances.* I think I was the first person to introduce the low-level safety track, having a rail height of only 14 in. from the ground, and which has now been adopted by other southern societies with great success. This low-level working seemed to give confidence to the very young, and for whom we cater largely, whilst the adults ride with reasonable comfort, sitting sideways with legs out straight and considering for how short a time they have to assume this posture.

In such circumstances, I consider foot-rests are not only unnecessary but positively dangerous. On one occasion, recently when I was asked to fit foot-rests, I was bothered with continuous derailings, due to the centre of gravity being upset when getting on or off the cars, and not for any other reason. I cannot see any way of altering this weight disposition problem without recourse to some system of positive railing such as the guide roller under the rail, but which introduces fresh problems of its own, which I will not enlarge on here.

I attended another function yesterday (at the time of writing) assisted by Mr. Perryman, of the Brighton Society, who did the lion's share of the driving, as I am not yet fit to do much; we did not have foot-boards fitted, and had no trouble at all. The number of passengers carried amounted to about 996; all in the space of about four hours, and bringing the total to about 51,980 passengers carried in just under five years; about 40 per cent. of these were adults (surprisingly enough) and no accidents or damage on record.

We had other problems, however. The site, which was said to be a level lawn, turned out to be medium grassland with a prevailing gradient of about one in ten. Starting off was achieved by clinging hard to the brake handle whilst loading up, and then releasing it gently. Coming back gave the celebrated imitation of the Lickey incline, but without the banking engine, and made us, out of sheer consideration for the engine, restrict the load to four adults plus the driver; as the driver, on his own admission, went somewhere in the neighbourhood of 15 stone, it was not a bad showing.

It happened that there were a number of locomotive experts round about, and it was agreed that in such circumstances, a $3\frac{1}{2}$-in. gauge locomotive would have been absolutely lost on the job, however good it might be in normal respects. Wheel slip would have killed any prospect of getting away from the bottom end, and it would have been sheer butchery to a good engine.

On another occasion, I was provided with a "clean dustbin" for a water supply, and clean it was at the start of the meeting. Before half an hour had passed, I counted four empty ice cream cartons, the remains of some unwanted cheese sandwiches, and a number of apple cores, all helping to thicken up the contents of the bin. To suggest that the injector is the only means of getting water into the boiler in an approved fashion, is sheer lunacy in the light of such conditions. All very nice when you are working at home, with carefully filtered rainwater, but give me my little steam pump which will pass anything up to about half the size of an apple pip if necessary, and I shall not worry about the water.

And just in case you think running engines at fetes is all fun and games, you still have to counter the irresponsible children who delight in putting stones under the locomotive wheels when you are not looking, or tipping earth down the chimney—no wonder we go grey at such an early age!

(To be continued)

King's Cross Centenary

On October 14th, 1852, the first train to use the then newly-completed London terminal of the Great Northern Railway, left for York at 7 a.m. In August of the same year the line was completed between Peterborough (Werrington Junction) and Retford, thus completing the East Coast main line to Doncaster as it is known today. Both these centenaries are to be celebrated at an exhibition to be held at King's Cross station in October, from Monday, 13th, to Saturday, 18th, inclusive.

The exhibition will be in two sections; a small exhibits and models section and a rolling stock exhibits section. It will cover the period of a full 100 years from 1852 to 1952 and will include examples of latest British Railways technical development and practice.

Many exhibits which would be suitable for this exhibition, relating to 100 years of development of the "Great Northern" main line, are known to be in private possession and contact is being made with railway societies and others interested with a view to privately-owned models and records being loaned for the occasion.

Organising the exhibition is Mr. M. B. Thomas, Public Relations and Publicity Officer, Eastern Region, Marylebone, London, N.W.1.

Using the Small Shaper

ALTHOUGH many flat surfaces can quite well be machined by a surfacing operation in the lathe, it is often more convenient to employ the shaping machine for this purpose. This machine is also an undoubted boon to those who have not acquired the art of forming flat surfaces by filing.

For many years, a Drummond hand-shaper served in the workshop for surfacing, machining V-slides, and cutting keyways, and this machine proved to be a very accurate and durable tool of first-class design.

From visits paid to small workshops, it would seem that the small shaping machine is now widely used, and is regarded by some as an almost indispensable part of the workshop equipment.

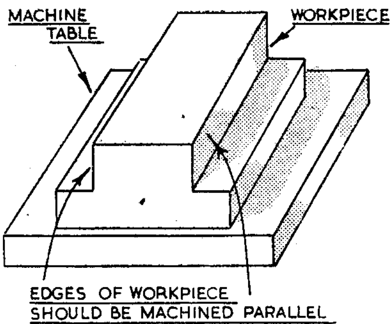


Fig. 2. Machining a parallel slide

There are, today, many makes of small, hand-operated shapers, but if a machine of this kind is to be of real use and capable of doing serious work, it must be accurate and of sufficiently rigid construction to withstand taking moderately heavy cuts. These requirements are met by the provision of accurately machined and hand-scraped slides, and the use of well-proportioned, heavy castings for the basic parts of the machine ; the performance of the now obsolete Drummond shaper no doubt depended largely on the attention given to these important features.

Installing the Machine

When machining rough castings, time will be wasted if the work is set so that much material has to be removed in one place before a level surface is obtained.

To obviate this, the machine table should be set exactly horizontal with a spirit-level when mounting the machine on the bench. If the work is then levelled in the same way, the minimum of machining will be needed before the tool cuts over the whole surface. The levels fitted to gun sights are sufficiently sensitive for this

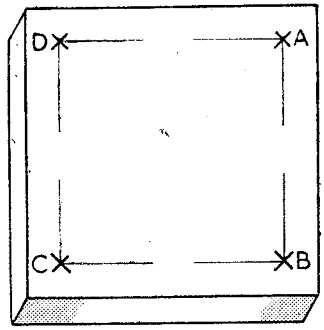


Fig. 1. Testing the alignment of the table and ram slide

purpose, and these instruments can usually be bought as war surplus material.

Accuracy of the Machine

At the outset, it is perhaps advisable to check the accuracy of the machine by making a few simple tests ; for if the work, after being shaped, has to be trued by filing, the machine largely fails in its purpose.

Attach the test indicator to the toolpost of the machine and, with the plunger of the indicator in contact with the table, move the ram in both directions to the full extent of its travel, first with the table traversed fully to the left and then to the right.

Comparison of the readings obtained at the four corners of this rectangle, as represented in Fig. 1, will indicate the accuracy of the ram travel in relation to the work table. When carrying out this test, it is important to see that the slide gibs are correctly adjusted. When making slides, it is important that, as represented in Fig. 2, the contact surfaces should be machined parallel, and to ensure this the ram should be free from

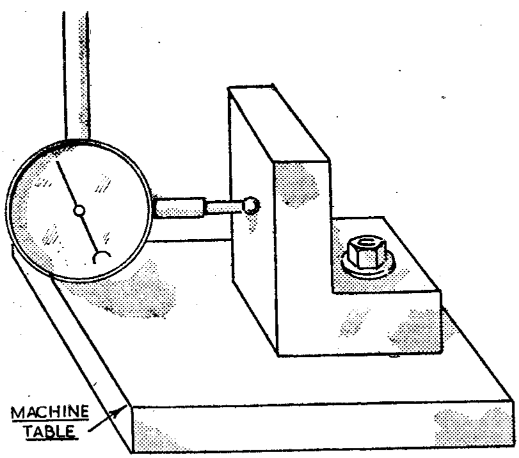


Fig. 3. Method of detecting side-shake in the ram slide

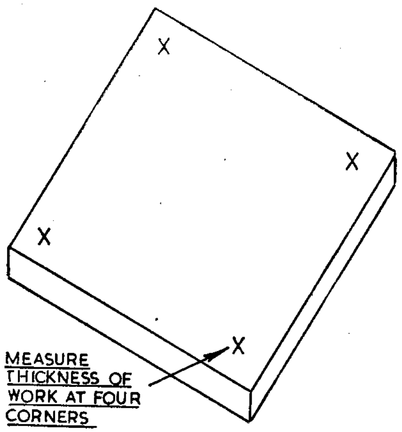


Fig. 4. Measuring a test-piece for accuracy of machining

side shake ; while adjusting the gib concerned, any shake can be demonstrated by applying the test indicator to a vertical surface in the way shown in Fig. 3.

As most machining will, perhaps, be done with the work held in the machine vice, it is important that this fixture, too, should be accurately finished, so that the surface on which the work rests lies exactly parallel with the under side of the base.

Some vices are finish-ground on both these surfaces, and their accuracy should then be beyond question.

With the vice bolted to the work table of the machine, the work face can be checked for parallelism in the same way as the table surface was tested. In addition, the face of the standing jaw should be checked with the aid of an accurate try-square resting on the work face of the vice.

A final test is carried out by trying the machine under working conditions. For this purpose, a piece of flat stock, say, 2 in. square and $\frac{3}{8}$ in. thick, is gripped in the vice in level contact with the work face. After a cut of moderate depth has been taken over the whole surface, the work is turned over, without turning it end-for-end, and the other surface is machined. To test the accuracy of the machining, the thickness of the work-piece at its four corners is measured with a micrometer, as represented in Fig. 4. In our workshop machine the error found by applying this test is less than a thousandth of an inch.

A worn machine or one that has suffered misuse may not be found accurate in all the respects mentioned, and, here, the manufacturers will no doubt help, for good machines are accurately made in the first instance.

Shaping Tools

For forming a flat surface on a work-piece mounted horizontally on the table of the machine, the ordinary knife tool will serve well, and it is made either right- or left-handed according to the direction of the cut. Side-rake should be given for machining cast-iron and steel, but for brass the rake is omitted. If the tool is ground with a sharply-pointed tip, a series of grooves will be formed on the work, and their spacing will, of course, correspond with the amount of feed given at each stroke. To obtain an evenly-finished surface, a small flat should be honed at the tip of the tool, as shown in Fig. 5, and the length of the

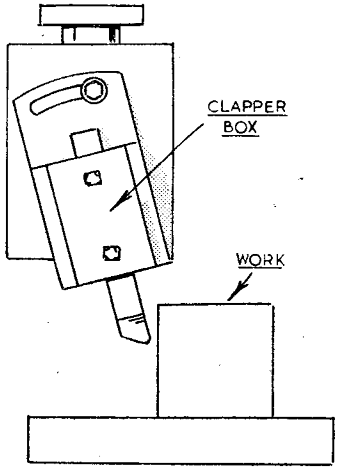


Fig. 6. Setting the clapper box for machining a vertical face

flat should not be less than the amount of feed used for traversing the tool. A good finish may also be obtained by slightly rounding the tip of the tool and using a fine feed. It is essential, however, to limit the length of the flat on the tool in accordance with the capacity of the machine to withstand the cutting pressure, for if too large an area of the cutting edge is brought into contact with the work, chatter and irregular machining will result. When taking roughing cuts, grooving of the work does not matter, but it should be possible to give the work a high finish with the finishing cut.

Tungsten carbide tipped tools will be found excellent for machining iron castings, as they seem highly resistant to wear and are but little affected by surface scale and sand. However, care should be taken not to submit the cutting edge to heavy shock when machining an irregular surface, for the tip material is more brittle than tool steel.

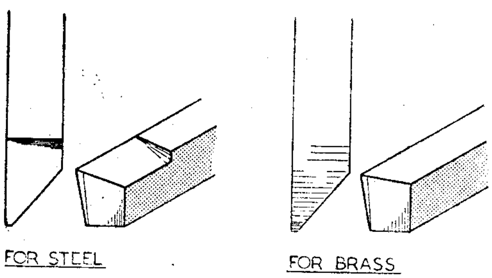


Fig. 5. Knife tools used for shaping

Machining Hints

When traversing the table by means of the automatic cross feed, the feed gear should be set so that the feed is put on during the idle or return stroke, otherwise the cut will run in an oblique direction and, at the same time, an unnecessary strain will be thrown on the feed gear.

Should the feed gear tend merely to rock the feedscrew backwards and forwards, the thrust-nut at the end of the feedscrew should be tightened, or a spring-loaded friction pad can be fitted to press directly on the feedscrew and give the necessary control.

Where the cut is taken against an inclined or vertical face, as in Fig. 6, the clapper box must be set so that it is inclined towards the work face ; this is necessary in order to allow the tool to rise freely and clear the work on the idle stroke. Should there be any difficulty about this when machining an undercut face, the best plan to adopt is to lock the tool so that the clapper box becomes inoperative, and a simple method is that illustrated in Fig. 7, where a bolt is placed against the upper end of the tool and the nut is unscrewed until the toolholder becomes securely locked.

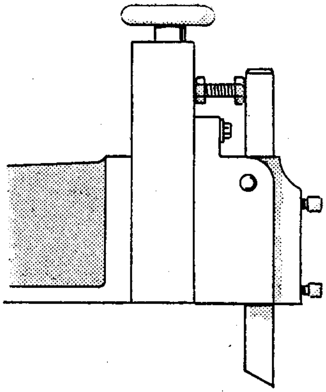


Fig. 7. Locking the clapper box with a bolt

PRACTICAL LETTERS

Hand Scraping

DEAR SIR,—As a machine tool fitter of many years' experience I was naturally interested in Mr. L. H. Sparey's article on the above subject, and in the letter from Mr. K. A. Hellon.

In spite of Mr. Hellon's assertions to the contrary, I can assure readers that the type of scraper advocated by Mr. Sparey is quite well known in the trade, and in the opinion of many " old hands " is probably the best type for the very good reason that scratching is eliminated. During my years as a machine tool fitter in one of the largest works in England with a plant of over 2,000 machine tools to be repaired and overhauled, this type of scraper was used almost to the exclusion of any other.

In my occupation I am scraping all day, very often for several weeks without a break, and I cannot agree that it is a simple process. Regarding the surface plate which Mr. Hellon mentions as having been perfectly finished by a team of girls, I rather suspect that he has left out the most important point ; namely, that the girls were under expert supervision. It is knowing what to do when things are going wrong that call for the skill and experience.

As to assuming that a surface is flat in the first place, I see no reason why Mr. Sparey or anyone else should not assume a machine surface to be flat if it shows no sign in use of being otherwise. In fact, the breaking up of machine surfaces is a routine practice and no regard is paid to the flatness of the surface. It is not, in fact, a truing process at all. For example, in precision grinding machines a common annoyance is that the wheel head often becomes " sticky," and a stiffness develops that makes that final 0.0001 in. cut almost impossible to obtain. The sliding surfaces have " mated " together and the motion has become jumpy. The head has to be removed and the surfaces broken up by scraping to allow that all-important film of oil between the surfaces. And there is the case for breaking up a surface where the matter of flatness is not questioned, and the many hours of lost production for checking for alignment, etc., would be futile.

In my opinion, Mr. Sparey's article was quite sound, and although it could have been amplified a great deal, amateurs will not go far wrong in following the advice.

Yours faithfully,

Palmers Green. E. F. G. UPTON.

Speed Control of Small Motors

DEAR SIR,—As an alternative to resistance speed control for his proposed sewing machine drive (Query No. 9963, July 31st, 1952), I would suggest to " A.J.W." that he consider a variable speed drive.

I had the same problem three years ago, and also hoped to use an induction motor, with which resistance control is unsatisfactory.

THE MODEL ENGINEER came to the rescue by publishing (page 711, No. 2507, Vol. 100, June 9th, 1949) an article by J. Rodway, A.M.I.Mech.E., " A Variable-speed Gear—A Novel Application of the ' 1831 ' Transmission Gear." With suitable modifications this has proved very satisfactory.

I would be pleased to give further particulars to A.J.W. if he wishes to pursue the idea.

Yours faithfully,

Palmerstown, Co. Dublin, Eire. W. KNIGHT.

[The original description of the " 1831 " variable speed gear, together with full working drawings, was published in the issue of THE MODEL ENGINEER dated May 14th, 1942.—EDITOR, " M.E."]